Metallurgist

МЕТАЛЛУРГ

NUMBER 3 1961

METALLURGIST

METALLURGIST is published in translation by the Board of Governors of Acta Metallurgica, with the financial support of the NATIONAL SCIENCE FOUNDATION.

An arrangement with Mezhdunarodnaya Kniga, the Soviet Book Export Agency, makes available both advance copies of the Russian journal and original glossy photographs and artwork. This serves to decrease the necessary time lag between publication of the original and publication of the translation and helps to improve the quality of the latter.

The translation and production of METALLURGIST are being handled by Consultants Bureau Enterprises, Inc.

Translation Editor:

PROFESSOR BRUCE CHALMERS, *Harvard University*

Acta Metallurgica is an International Journal for the Science of Metals. It is sponsored by the AMERICAN SOCIETY FOR METALS and the AMERICAN INSTITUTE OF MINING, METALLURGICAL, AND PETROLEUM ENGINEERS and is published with the cooperation of the following societies:

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Issued monthly. One volume per annum consisting of 12 issues and containing approximately 50 pages per issue.

Annual subscriptions (which must be paid in advance) are:

To libraries, institutions, and individuals, $25.00 (£ 9) including postage.

To members of cooperating and sponsoring societies of Acta Metallurgica, $12.50 (£ 4/10) including postage.

Single issues, $4.00 (£ 1/3).

Orders should be sent to: BUSINESS MANAGER

ACTA METALLURGICA

122 EAST 55TH ST. • NEW YORK 22, N. Y.

METALLURGIST

A translation of METALLURG, the monthly industrial technical journal of the Ministry of Iron and Steel of the USSR

Translation published October, 1961

No. 3, pp. 101-150 March, 1961

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PROSPECTS OF THE FUTURE

Translated from Metallurg, No. 3 ,
pp. 1-3, March, 1961

Not much time has elapsed since the day when the entire country learned about people who decided to live and work communistically, about people who now can be called prospectors of the future. During this relatively short period of time the movement for the right to be called a Collective and a Shock-Worker of Communist Labor has acquired, in truth, a massive character and left its impression on every aspect of life in our society.

The managers of the enterprises have now subordinated their entire work in the field of organizing and supervising socialist competition for the prescheduled fulfillment of the Seven-Year Plan to the future development of the movement of Collectives and Shock-Workers of Communist Labor.

In order to popularize this patriotic movement, large-circulation newspapers, radio, express-telegrams, rallies of participants in the competition, and many other forms of agitation and propaganda are used.

The trade-union factory committee of the "Zaporozhstal' " Plant has organized regular speeches by the leaders of the collectives competing for this high rank. In the dormatories, schools for foremen, and university of Communist Labor and Mode of Life, the workers, engineers, and technicians of the plant and members of their families frequently meet with the leaders of those collectives that have decided to live and work communistically. Thus, the foremen of the blast-furnace shop, Comrade Voloshin, steelworkers P. Zalozh and I. Kaela, senior pickler of the cold-rolling shop, Comrade Seregin, and others gave an account at the plant University of Communist Labor, Life, and Culture concerning the labor achievements of the collective and the struggle of its members for a high culture and healthy way of life.

The large and diverse, massive, explanatory organizational work of the trade union committee and mainly the desire to follow the example of those who have decided to live and work communistically soon brought hundreds of thousands of metallurgists into the ranks of participants in the competition for the right to be called a Collective and Shock-Worker of Communist Labor.

The All-Union Conference of Outstanding Workers in the Competition of Brigades and Shock-Workers of Communist Labor, held in May of last year, played an enormous role in the development of this glorious movement

At present the communist labor movement has entered a new stage of development: now not individual brigades but entire collectives of the largest metallurgical plants and combines are contending for the right to bear the title of an Enterprise of Communist Labor.

The collectives of the Magnitogorsk and Nizhne-Tagil Metallurgical Combines, the "Zaporozhstal' " Plant, Zakavkazskii Metalurgical Plant, "Krasnyi Oktyabr' " Plant, Leningrad Steel Rolling Plant, "Dneprospetsstal' " Plant, the Novomoskovskii Metallurgical Plant, the Lenin Tube Plant, and many others have resolved to win this honorable title by unyielding and persistent work.

Just in one city, Zaporozh'e, the collectives of many plants, which are serviced by the trade union of workers of the metallurgical industry and which employ more than 45,000 workers, engineers, and office personnel, are participating in the competition for the right to be called an Enterprise of Communist Labor. More than 60,000 metallurgists are contending for this title at the metallurgical enterprises in the Chelyabinsk region, the same number in the Dnepropetrovsk region, more than 160,000 in the Sverdlovsk region. Tens of thousands of workers, engineers, and technicians of metallurgical enterprises have participated in this competition in the Kemerovo, Stalino, and other regions of the country.

The participation in the struggle for the right to be called an Enterprise of Communist Labor has changed the character of the socialist obligations. Now they combine the endeavor to increase the production level with the desire to study, to increase working qualifications, to make still more joyous and well-arranged the way of life. The news of the convocation of the Twenty-Second Congress of the Communist Party of the Soviet Union activated this struggle still more.

The collective of the Magnitogorsk Combine in their pledges in honor of the Twenty-Second Congress of the CP of the Soviet Union, in addition to the increase in the output of goods, improvement in the technical and economic indexes, and introduction of new techniques, pledged for 1961 to bring up to 7000 workers the contingent of students in institutes, technical schools, schools for the working youth, and at courses for foremen. The workers have started the construction of an asphalt road to the site of the rest camp for the Magnitogorsk workers (Lake Bannoe); they have broken ground around the shop for flower beds and have planted flowers, each worker of the combine is to plant one tree in 1961 in the plant territory and in town.

The Twenty-First Congress of the Party and the June (1959) Plenum of the Central Committee of the Communist party of the Soviet Union pointed out a specific course for realizing the grandiose program of the Seven-Year Plan based on the introduction of large-scale mechanization and automation of production, new techniques, and progressive technology into industry.

The participants in the competition of communist labor are the most active supporters of everything new, advanced, and progressive. Understanding that knowledge is necessary for mastering the new technology, they all devote their free time to increasing their general-educational and industrial and technical level. The mass endeavor of the participants in the competition to learn made it necessary to considerably enlarge the network of industrial and technical training.

The trade union committees together with the executive managers at most enterprises, following the initiative of the "Zaporozhstal' " Plant, have worked out a promising plan for increasing the general-educational and technical knowledge of the workers. Thus, at the K. Libknetkht Tube-Rolling Plant 8595 persons will increase their general-educational and industrial and technical level during 1960-1965; more than 17,000 persons will be trained according to a six-year plan at the Cherepovets Metallurgical Plant. Moreover,these plans are being successfully accomplished.

Presently at the Serov Metallurgical Combine, 703 persons are studying at the school of working youth, 153 at the metallurgical technical school, 197 at the evening institute, 881 are being trained at various circles of technical study, 2383 are involved in political education. More than 4000 persons were trained in the past year at the Cherepoverts Metallurgical Plant. Such examples are numerous.

The participants in the competition for the right to be called a Collective and Shock-Worker of Communist Labor show great interest in the economics of the enterprises, attempt to analyze more profoundly the problems of labor organization and production, material and technical supply, and financing.

The factory trade-union committees of the Nizhne-Tagil Metallurgical Combine and the Serov Metallurgical Combine are carrying out considerable work to organize the training in economics. Circles and seminars have been established at the combines for studying the economics of the enterprises; at these meetings the department supervisors and the shop chiefs discuss certain economic points, using for this purpose local examples from managerial experience at the enterprise. More than 2600 persons have taken up training in economics at the Serov Metallurgical Combine alone.

Knowledge of economics helps the participants in the competition to find shorter routes in the struggle to lower the cost of production, to increase the productivity of labor, to improve the quality of the product, to reduce breakage-down times, and nonproductive losses of working time. The workers of the Nizhne-Tagil Metallurgical Combine have derived great benefit in increasing their knowledge of economics from the correspondence seminar in economics which is organized on the pages of the widely circulated newspaper "Tagil Metallurgy," where for the past year Comrade Petrov, chief steelmaker, Comrade Zhuravlev, Chief of the Planning Department, Comrade Lapikov, representative of the trade-union factory committee, and others have come out with articles concerning specific economic structures.

The endeavor to improve labor conditions and production, to search constantly for new potentials for the maximum use of the units and equipment, is one of the most remarkable qualities of the prospectors of the future. These qualities combined with the enormous drive for knowledge are already yielding perceptible results, which are manifested in the significant increase in the ranks of inventors and efficiency experts at the enterprises, especially where the collective has fully resolved to contend for the right to be called an Enterprise of Communist Labor.

The collectives of the Magnitogorsk Metallurgical Combine, the Pervoural New-Tube Plant, the "Zaporozhstal' " and "Dnepropetsstal' " Plants and many others fought for first places in the recently held All-Union review for the best enterprise of the metallurgical industry in the field of inventiveness and efficiency suggestions.

At the Magnitogorsk Combine, for example, more than 7000 suggestions from effieciency experts were submitted last year, of which more than 4500 were put into practice, resulting in a savings to the combine of more than 40 million rubles.

In regard to all those competing for the right to be called a Collective and Shock-Worker of Communist Labor, the participants of the All-Union Conference suggested adding to the slogan, "Study, Work, and Live Communistically," a fourth precept, "Pass your Experience on to Another." This slogan was warmly seconded.

Along with the regular intraplant and shop schools of advanced experience and the participation in the interplant schools and the issue of various placards, new forms of propagating advanced experience have been developed.

In 1959, Zalozh, Gubar', Shestakov, and Moiseenko, steelworkers of the No. 8 furnace of the "Zaporozhstal' " Plant, smelted in their furnace a world's record amount of steel: 237,512 tons. Placards were printed and brochures issued in order to propagate the experience of their work. But something else was of greater benefit. Steelworker P. Zalozh was released from work at his furnace and for 40 days smelted steel from shift to shift at other furnaces of the mill. This form of propagating experience helped raise the 1960 output of the furnace to the level of the most advanced furnaces. Comrades Yakolev, Zinov'ev, Gertsenok, and Kobylko, steelworkers of the second furnace smelted 250,600 t of steel in their furnace in 1960. The brigade of Kobylko, like Zalozh's brigade in its time, passed its experience on to other steelworkers of the shop by working at different furnaces.

Such a form of propagating advanced experience is also widely used at the Novosibirsk Metallurgical Plant. The workers in the heat-treatment department of the cold-rolling shop convincingly proved that much can be gained in one's own shop, even from the comrade working along side.

At other metallurgical enterprises, different but no less beneficial forms of propagation of advanced experience are being developed, such as sending brigades to study at released enterprises.

A long friendship, strengthened by competition binds the collectives of the blast-furnace shops of the "Zaporozhstal' " and Cherepovets Plants. The blast-furnace operators decided to exchange industrial brigades and to work with each other for three months. Thus, in the past year the Cherepovets brigade, consisting of the foreman, hearth attendant, and gas attendant, worked at the "Zaporozhstal' " Plant, and the "Zaporozhstal' " workers at the Cherepovets Plant.

This form of teaching the advanced methods of labor is now being used at the Serov Combine, the Novosibirsk Matallurgical Plant, and at the Nizhne-Tagil Metallurgical Combine.

The struggle for the right to be called a Collective of Communist Labor has already extended beyond the enterprises. In July of last year at the All-Regional meeting of workers of the Ordzhonikidze region at Zaporozh'e, it was resolved to participate, after the example of Sevastopol, in a rivalry for the title of Region of Efficient Labor, Exemplary Social Order, and High Culture.

In Cherepovets, for example, in the houses where the metallurgists live, a competition for a communist household was organized. The inhabitants of each house pledged themselves; underlying these pledges were the principles of the struggle for strengthening friendship, comradeship, and mutual help in the family, apartment, and home. In house No. 59 on Engels Street, on the initiative of the inhabitants, a competition was recently carried out for the best sanitary and hygienic condition of the apartment and sanitary-everyday rooms. The inhabitants cleared the yards and readied the trees for winter.

Cases of violating labor and industrial discipline became fewer at the enterprises and truancy considerably declined.

Having pledged to work, live, and study communistically, the collectives of the metallurgical enterprises are carrying out significant work for increasing culture, production, training of new men, and the development of communist principles in various aspects of industrial life.

The factory committee of the trade union of the "Dneprospetsstal'" Plant together with the director of the plant resolved, for example, to abolish the table system at the plant. The workers of the table-instrument shop, stripping, hot-gaging machine, electrical repair, and other shops on their own initiative, refused janitors. They themselves put their own working places in exemplary order and cleanliness and painted the shop in colors. In the control and measuring instrument shop, the automatic-machine workers have decided to receive their wages without a cashier. There are many such examples.

By selfless labor and persistent study many collectives and individual workers won the esteemed right to bear the high rank of Collective and Shock-Worker of Communist Labor.

Tens of shops have already been honored with the high rank: these include the blast-furnace and wire-strip shop at the Magnitogorsk Metallurgical Combune, the blast-firnace shop at the Cherepovets Metallurgical Plant, the universal-iron shop at the Dzerzhinskii Plant, the No. 1 steelmaking shop at the "Dneprospetsstal'" Plant, and many others.

The collective of the Nizhne-Tagil Metallurgical Combine takes pride in their fellow steelworkers Yu. Zashlyapin, T. Obraztsov, Ya. Kal'nichenko, and Yu. Ploskonenko, who have attained the highest index of utilization of open-hearth furnaces and who received a warm greeting from N. S. Krushchev.

The entire country knows Heroes of Socialist Labor, foremost workers and organizers of competition for communist labor in ferrous metallurgy, A. I. Volkov, senior rolling-press operator at the "Zaporozhstal'" Plant, A. V. Dzamashvili, foreman of the blast-furnace shop at the Zakavkazskii Metallurgical Plant, Said Nurutdinov, foreman of the rolling shop at the V. I. Lenin Uzbek Metallurgical Plant, A. V. Morogov, steelworker of the open-hearth furnace at the Nizhne-Tagil Metallurgical Combine. D. S. Obydennyi, senior rolling-press operator of No. 2 at the Lys'va Metallurgical Plant, V. F. Pil'tyai, shift foreman of No. 12 blast furnace at the Dzerzhinskii Plant, P. I. Fedyaev, steelworker of No. 3 open-hearth shop at the Magnitogorsk Metallurgical Combine, and many others.

The army of metallurgists, people of a hot profession, devoted fighters for communism, march in the front ranks of the workers of socialist industry.

IMPROVED SINTERING CHARGE IGNITION

Engineers A. P. Ryazantsev and Yu. V. Simakov, and Cand. Tech. Sci. S. V. Bazilevich

Nizhne-Tagil Metallurgical Combine

Translated from Metallurg, No. 3, pp. 4-5, March, 1961

In the sintering machines of the Nizhne-Tagil Combine, the charge is ignited by furnaces using coke breeze 10 to 40 mm in size ("small nuts"). The fuel is fed manually to the furnace at intervals For improving the mechanical strength of the sinter, investigations have been made with the object of ascertaining the possibility of increasing the efficiency of ignition. A chromel-alumel thermocouple was placed below the furnace with the hot junction 100 mm above the surface of the charge and at a distance of 500 mm from the edge of the palette. Samples of gas were taken for analysis from the same point by means of a water-cooled tube.

The variation in temperature and composition of the combustion products during the cycle (interval between feeding the coke) was investigated. In addition, the consumption of fuel for ignition was noted and the strength of the top layer of the sinter was determined. For this purpose, during a cycle, the top layer of the final sinter was broken up several times over an area of 800 x 400 mm above No. 6 suction box (at a distance of about 11 m from the flame zone). The depth of the layer was about 60 mm. The sample was tested by P. G. Rubin in the drum by the standard method.

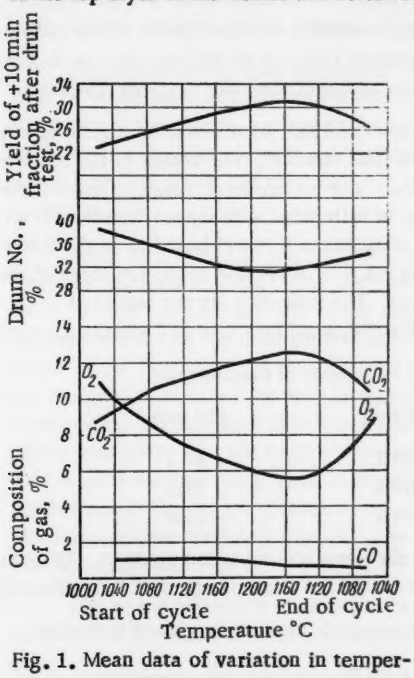

Fig. 1. Mean data of variation in temperature, composition of combustion products and strength of upper part of sinter in the course of a working cycle of the furnace.

The blast for burning the coke breeze was not regulated, but it varied in the course of a cycle. Immediately after a periodical charge of coke, the resistance of the fuel bed to gas flow increased, as a result of which the volume of the heating gases became less than the volume drawn by the fan through the sintering charge in the ignition section. In addition to combustion products, therefore, atmospheric air was also drawn through this section. With the combustion of the coke, the resistance of the fuel bed to the flow of gas diminished and the volume of heating gas increased. Even in the middle of the cycle, it was observed that flames were forced out between the sides of the furnace and the edges of the palette. Figure 1 shows the variation in temperature, composition of the combustion products and strength of the top sinter layer in the course of a cycle.

Figure 1 shows that the strength of the top layer of sinter depends on the temperature and composition of the heating gases. Due to the aspiration of atmospheric air during the first half of the cycle, for the same temperature, the oxygen content of the combustion products is higher than in the second half. Correspondingly, the strength of the sinter is higher in the second half of the cycle, for the same temperatures. This shows that temperature is not the only factor determining the efficiency of ignition.

The composition of the gas is no less important. A large excess of oxygen in the heating gas obviously results in premature combustion of the fuel in the top layer of the sinter charge, and a more rapid cooling of the sinter formed there on emerging from below the furnace. With a lower oxygen content of the heating gases, more carbon is retained in the top layers of the charge in the ignition section, and this carbon burns beyond the limits of the section under the furnace, thus preventing rapid cooling of the sinter.

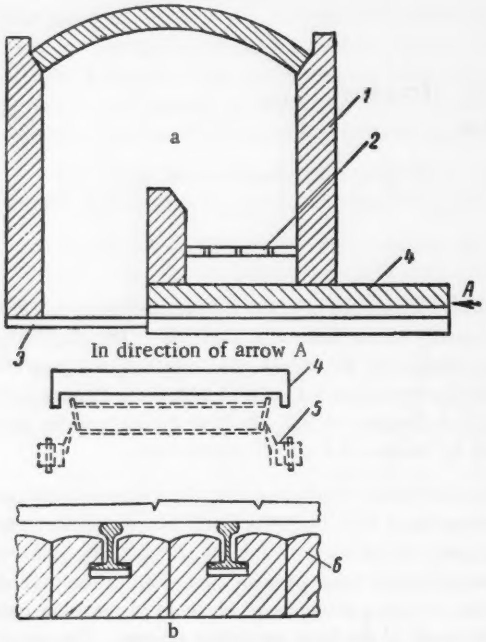

Fig. 2. Diagram to show installation of the screen a) General view; b) detail of screen: 1) Furnace; 2) grate; 3) coolers; 4) screen; 5) palette; 6) firebricks.

The duration of the cycle and the quantity of coke fed to the furnace are of essential importance. In the course of the investigations, the duration of the cycle varied from 5 to 16 min, the quality of coke charged from 25 to 93 kg, the depth of the fuel bed on the furnace grate varied from 26 to 95 mm, and the fuel consumption from 5 to 12 kg/min.

It was found that long cycles and a larger amount of coke fed gave a more pronounced variation in the temperature of the gas during the course of the cycle and did not permit the process to be carried out economically. (The carbon monoxide content of the heating gases in the middle of the cycle attained 7.5%.) The shorter the cycle, the more uniform is the attainable ignition of the sintering charge. Taking into account actual productive possibilities, the following working conditions were established for the furnaces:

Duration of cycle, min	5
Quantity of coke charged, kg	30
Specific fuel consumption kg/min	6

A further reduction in the duration of the cycles down to continuous charging of the fuel may be decided on the mechanization of the coke charging operation.

In November, 1959, some sintering machines were equipped with heat screens*. The cooler of the furnace was dismantled and on its steel construction was fixed a covering of rails lined with shaped firebricks (Fig. 2). The total length of the screen is 3.6 m. The provision of this screen reduces the external heat loss as the sintering charge emerges from the flame zone of the furnace and diminishes the rate of cooling of the top layer of sinter. The mechanical strength of the top layer is consequently increased. The following are the results of comparative tests of samples taken by the method described above from sintering machines with and without screens:

	Contents of Fraction, %	
	-5 mm	+10 mm
Sintering machine A, without screen	38.1	27.2
Sintering machine A, with screen	32.5	27.5
Sintering machine B, with screen	34.5	31.2

The provision of the screen increased the area of aspiration of the furnace combustion products. The consumption of coke for ignition increased by 9.0%, while the carbon content of the sinter charge fell insignificantly.

It may be considered that the provision of screen is the first step toward, the introduction of combined heating of the sintering charge.

*At the suggestion of Yu. V. Simakov, G. Z. Trunov, Ya. N. Vydrin, and D. I. Gordienko.

THE MOVEMENT OF GASES AND MATERIAL IN THE BLAST-FURNACE

V. I. Loginov

Department of Pig-Iron Metallurgy, Dneprodzerzhinsk Metallurgical Plant
and Higher Technical School

Translated from Metallurg, No. 3,
pp. 6-9, March, 1961

In Metallurg, No. 8, 1960, an article by A. N. Chechuro and I. L. Kolesnik appeared: "Errors in Regulating Gas Flow and Distribution of Materials in the Blast-Furnace." One of the responses to this article appears below.

The efficient regulation of gas flow and material distribution in the blast-furnace ensures high technical-economical characteristics of blast-furnace smelting. Therefore, the question raised by A. N. Chechuro and I. L. Kolesnik in the journal "Metallurg" is a very important one, since radial and peripheral changes in composition and temperature of furnace gases is currently to become one of the objectives of complex, automatic regulation of the smelting process.

Departures from the formerly held notions of the distribution of regulation of gases along a diameter of the furnace and its periphery are to be observed in the practice of the smelting industry; this does not necessarily mean, however, that the earlier ideas were wrong.

Change in the composition and temperature of the gases is determined by the functioning at the top and bottom of the blast-furnace. With a constant charge and a given section of the furnace, this relationship is determined by the distribution of materials at the mouth and the incoming blast (its magnitude, temperature, pressure, natural gas and oxygen content, the location and diameter of the tuyeres, etc.).

The results obtained in regulating the gas stream by the charging system differ if the quality of feed, the level of the charge, and the surface profile, forming as a consequence of a cross-section variation in the speed of descent of the charge, are not the same. The parameters of gas flow are closely related to the movement of the burden in the blast-furnace. A redistribution of the ore component of the charge as a result of a cross-sectionally uneven descent of materials has an especially significant influence on the composition and temperature of the gas.

Study on a model of the distribution of materials during their movement has shown that, with a central ore path (the ore preceding the coke), the thicker layers of charge are concentrated in the center. In this case, if the ore is fine the gas permeability of the center decreases (the gas has a high CO_2 content and low temperature); the permeability of the intermediate section increases. With a coarse charge, the speed of movement at the center of the furnace is a maximum, and the gas permeability increases. An analogous redistribution of gases and material is observed in the peripheral movement of materials. In all cases, the charging system O-C* will correspond to an increased development of gas passages at the center, and the system C-O*, to a growth of peripheral passages. That the earlier views on the regulation of gas by the system of charging remain the correct ones is confirmed by many years of experience in furnace operation. As a rule, a maximum quantity of gas passes through the central portion of the furnace where the most rapid movement of materials is observed and where the coarser material is found. The CO_2 content of the gas is, in this case, a minimum, and the temperature is a maximum.

Due to the influence of the walls, an increased flow of gas is also registered in a narrow ring around the periphery of the furnace; this will increase still further with a peripheral movement of materials.

Experience in the operation of blast-furnaces and study on the model of the effect of the charging system on the distribution of materials show that, if the ore component of the burden is well prepared, no essential difference in regualtion with either of the charging systems O-C or C-O will be observed.

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*O-C = coke on ore ; C-O = ore on coke.

A model, 1/20 th actual size, of the blast-furnace with a volume of 1386 m^3 (Fig. 1) was build in order to study the gas distribution. A "dome" with four concentric rings of equal gage was fastened to the top of the furnace. The quantity of gas passing through each section was measured by means of vane anemometers. The cross-sectional distribution of gas was studied during the movement of materials, for which purpose the model was mounted on a hermetic bin containing a disk feeder, actuated by a suitable mechanism. The results of the measurements are given in Table 1.

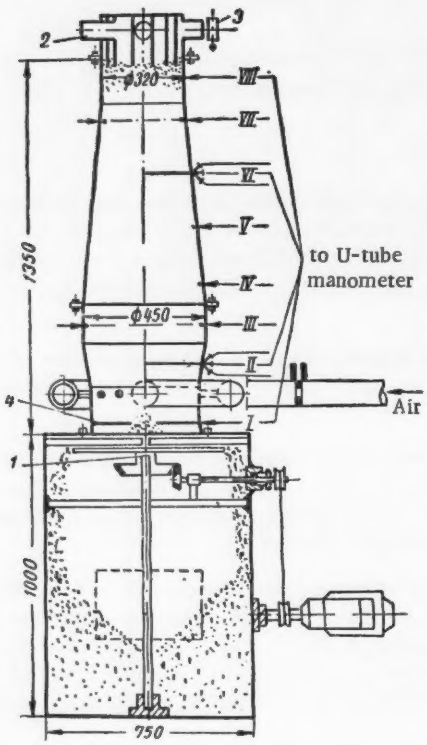

Fig. 1. Model for studying the distribution of gas flow and the static pressure in a layer of moving materials. 1) Disk feeder; 2) "dome"; 3) anemometer; 4) replaceable bottom of the model.

From Table 1 it is evident that both with peripheral (60 mm/min) and central movement of materials, the greatest quantity of gas (using corresponding quantities of blast) passed through the central part of the furnace. This is explained by the location of the coarser material in the center of the furnace and a corresponding redistribution of it during movement. The speed of descent of materials within the range 25-200 mm/min did not appear to have any substantial effect on the resistance to gas flow. This effect actually exists only during the transition as material passes from a stationary to a moving condition. Moreover, the influence of the charging system on the distribution of gas flow is negligible.

Study of the model shows that the distribution of gas flow is influenced not only by the leading material charged (ore or coke), but also by the one charged last, since the last layer of materials, during its descent, undergoes the greatest redistribution. With central movement, the last layer is concentrated primarily in the center of the furnace, and this may occasion a redistribution of gases if the order of changing the last skips is changed.

The nature of the descent of materials in the upper regions of the furnace may vary also. The burden may descend evenly or with some sagging, which influences the surface profile and the distribution of gasses and materials.

A cross-sectionally uneven movement of material leads to a distortion of the surface profile which may influence the distribution of materials at the mouth and affect the redistribution of the gas flow (Fig. 2). A sharp change in profile such as that shown in Figure 2 is seldom observed.

In operating furnaces it is observed, as a rule, that when the CO_2 content on the periphery rises sharply, the pressure drop between the mouth and the blast main also rises; i. e. gas permeability decreases. This is observed more often when the materials are charged with the ore leading. When coke was charged first and the last skips supplied ore, the total pressure drop decreased, and the CO_2 content decreased on the periphery and increased sharply at the center (Table 2).

The change in the distribution of materials and gases in the blast-furnace is most clearly and conveniently expressed by the upper pressure drop (Fig. 3). Changing the system of charging from C-O-O-C-L-O* to O-O-C-L-C-C on one of the furnaces of the Dzerzhinsk plant resulted in an increase of the upper pressure drop along the height of the furnace and a decrease in the lower drop. The CO_2 content at the periphery increased, and there was some rise in the temperature of the gas. After returning to the former system of charging, the pressure drops, gas composition, and temperature gradually assumed their previous values.

The effects described by A. N. Chechureo and I. L. Kolensnik do, in fact, occur at the Dzerzhinsk plant, but they can be regarded only as exceptional instances. Usually, the effects observed are the reverse of those described in their article. The temperature is higher, but the CO_2 content is lower in those regions through which

*L = Limestone.

TABLE 1

Cross-Sectional Distribution of Gas

Conditions	Cross-sectional distribution of gas, %: periphery	intermediate	section	center	Static pressure in the center of the shaft, mm of water: periphery	intermediate section	center
Material right after charging, in a stationary state	42	28	18	12	90	95	100
Central movement of materials, charging system O–O↓ C–C↓	22	19	25	34	65	70	30
The same, charging system C–C↓ O–O↓	23.5	20.5	24	32	65	70	30
Peripheral movement of materials, charging system O–O↓ C–C↓	24	21.5	23.5	31	55	65	40
The same, charging system C–C↓ O–O↓	25	22	23	30	55	65	40

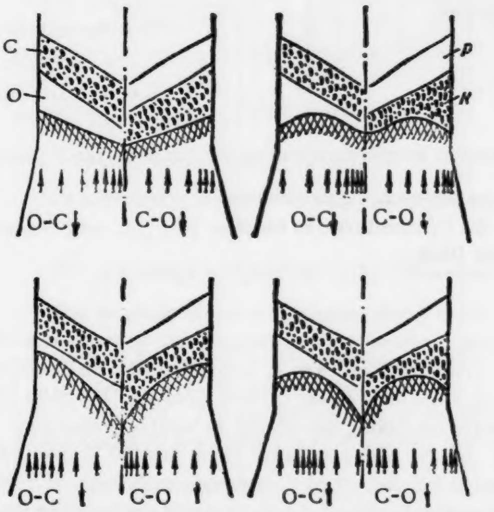

Fig. 2 Charging materials onto a burden of various profiles (spacing of the arrows conventionally represents the change in gas flow).

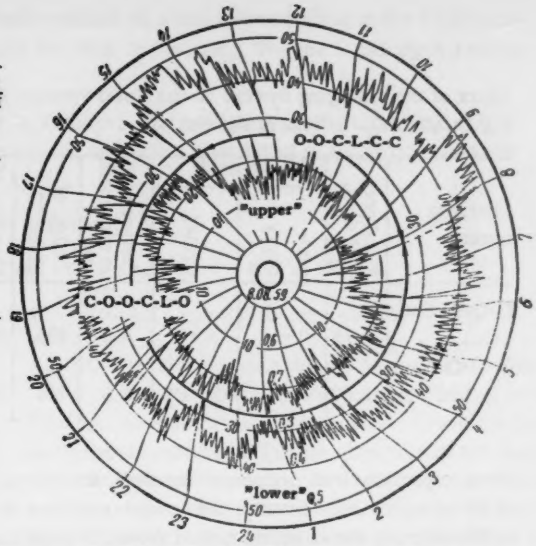

Fig. 3. Combined graphs of the upper and lower pressure drops when charging according to the systems C-O-O-C-L-O and O-O-C-L-C-C.

more gas moves. This is usually observed in the gas permeable zones of the furnace (the narrow peripheral ring and the central part of the furnace) where the coarser material is located. It is difficult to imagine a furnace zone where materials move very slowly and are, therefore, heated from bottom to top in a manner such that the temperature of the gas should rise. In such zones, according to A. N. Chechuro and I. L. Koiesnik, as a result of poor heat transfer, the gas temperature will be higher than in zones of intense gas flow. This can occur only during the formation of an accretion. Usually, appreciably less gas passes through the zones of low permeability, and if a sufficient quantity of ore is present the temperature here will be lower.

This is confirmed by the radial distribution of CO_2 and temperature. The greatest amount of gas flows through the narrow peripheral ring and the center of the furnace. In these zones, the highest temperatures and highest CO_2 content are seen to accompany the most intense flow of gas. In the intermediate rings where the flow of gas is less intense, the CO_2 content reaches its greatest value, but the temperature of the gas is a minimum. Accordingly, the most intense movement of material is, in this case assumed to occur in the intermediate sections above the zones of combustion. Investigations on the movement of materials and gases carried out by I. G. Polovchenko show that the highest CO_2 content is observed in zones where the movement of materials is intense, but it does not necessarily follow that the flow of gas is correspondingly the most vigorous there, as asserted by A. N. Chechuro and I. L. Kolesnik. Investigations on the model show that a strong stream need not coincide with a zone of most intensive movement. Moreover, the movement of materials (central and peripheral) does not appreciably influence

TABLE 2

Effect of the Charging System on the Total Pressure Drop and On the CO_2 Content of the Gas

Charging system	Total pressure drop, atm	CO_2 content		Gas pressure at the mouth, atm	Temp. of blast, °C	Quantity of blast, m^3/min
		periphery	center			
O-O-L-C-C-C.	1.18	9–16	6–9	0.6	695	3200
C-C-O-C-O-L.	1.07	5–9	9–12	0.6	700	3200

the cross-sectional distribution of gases in the model. However, the descent of the burden does affect the redistribution of materials, especially the ore component, leading to a change in the composition and temperature of the gas and promoting irregularity in its cross-sectional distribution.

In zones of intense flow of gases and materials, the temperature may be lower if a sufficiently large quantity of ore (agglomerate) is entering this part of the furnace.

The flow channels of the blast-furnace may be pictured as places of rapid descent of materials, and, in the presence of a sufficient quantity of ore, the CO_2 content may be increased and the gas temperature decreased. This is not always the case, however. More often, especially with peripheral channels, the passage is formed as a result of gas breaking through individual portions of the charge. Consequently, the temperature here rises, and the CO_2 content decreases. When channels are formed in this manner, the charging system should be regulated, as done formerly.

THE MAGNETIZING CALCINATION OF ORES

(In countries, members of SEV)

G. V. Gubin, Technical Science Candidate
Mechanobrchermet

Translated from Metallurg, No. 3,
pp. 9-12, March, 1961

The article presents the basic results of research on the magnetizing calcination of ores carried out in the member countries of SEV: the Czechoslovakian Socialist Republic, The Rumanian People's Republic, and the USSR.

In 1959, the Czechoslovakian Scientific Research Institute carried out semicommercial investigations on the magnetizing calcination of iron ores in a cylindrical, revolving furnace 18 m in length and with an effective volume of 14 m^3. The furnace was fired with coal dust having a calorific power of 5500 kcal/kg. Limonite and siderite ores were calcined. The limonite ores were calcined after mixing the siderite in varying proportions, both with and without the addition of a solid reducing agent. Lignite with a calorific power of 3000 kcal/kg was used as the reducing agent. The original limonite ore contained 33% iron, 7.5% hygroscopic moisture, and 8.3% water of hydration. The siderite ore contained 25% iron. The particle size of the ore mixture was less than 30 mm.

It is evident from Table 1 that although the magnetizing calcination of limonite ores may be accomplished by simply heating them in a mixture with siderite ore, the addition of the solid reducing agent to the charge permits a significant reduction in total heat consumption. It is also apparent that when siderite ore alone is roasted, the unit output is appreciably higher than when only limonite is used.

During the investigations, it was established that the addition of a solid reducing agent with a high content of volatiles permits an expansion of the high temperature zone in the furnace and a reduction in the quality of heat liberated from the fuel in the burner. This has a positive effect on the operation of the furnace, since the temperature in the zone around the burner may be reduced, and the possibility of accretion formation is decreased.

At the present time, magnetizing calcination has been realized on a commercial scale in the Czechoslovakian Socialist Republic at two plants: one in Rudnyana and the other in Trzhints. The ore is calcined in reconstructed cylindrical furnaces formerly used in sintering.

One cylindrical furnace is in operation at the plant in Trzhints. The particle size of the ore used ranges from 0-25 mm and consists of a mixture of siderite with barite and negligible amounts of chalcopyrite and tetrahedrite.

The chemical composition of the ore is given below in percent:

Fe	Mn	SiO_2	Al_2O_3	CaO	MgO	S	Losses
53	3	5.4	2.5	0.4	4.3	1.2	0.5

Technological Data on the Calcination of Ores in an Experimental Cylindrical Furnce

Ratio of siderite to limonite in the charge	Unit output of furnace, tons/m³ 24 hr	Heat consumption, kcal/ton, in burning		Total heat consumption, kcal/t
		Lignite coal	Coal dust	
Siderite ore	4.11	–	371000	371000
4:1	4.05	–	390000	390000
2:1	3.08	–	505000	505000
1:1	3.17	–	524000	524000
2:1+ 6.5% angle	4.11	65000	358000	423000
2:1+ 10% angle.	2.74	100000	334000	434000
Limonite ore + 8% angle	3.17	240000	396000	636000
Limonite ore + 8.9% angle	3.09	276000	470000	737000

Note. Coal content is given as percentage of limonite ore.

Ore is released from the bin by means of a disk feeder onto a belt conveyor which carries the ore to the furnace. An electromagnet is mounted above the belt and removes extraneous foreign objects from the feed. After the dust settles out in the dust compartments and cyclones, it is moistened and returned to the furnace on scraper conveyors and bucket elevators. This leads to a reduction in the output of the furnace. A great amount of dust is released in the firing sections, due to the unsatisfactory performance of the dust collectors.

The cylindrical revolving furnace is fired with coal dust which burns in a turbulent, short-jet burner. The calcined ore is loaded into a drum cooler from which it passes to a planet cooler, the discharge end of which is furnished with a screen having apertures of 4 mm. The coarse material is crushed in a hammer mill, mixed with that which passed through the screen, and delivered by a bucket elevator to the beneficiation department where the ore undergoes dry magnetic separation on drum seperators of the "Humbolt" design.

To completely free the ore particles in the calcine, comminution to 2 mm is required; however, at the plant it goes only to 4 mm.

The percentage composition of the concentrate obtained after calcining and beneficiation is given below:

The recovery of iron in the concentrate is 88.7%.

Some of the technical and economical performance figures from the calcining mill of the plant at Rudnyana are to be noted. Heat consumption per ton of dry ore is 310-320 thousand kcal, and the consumption of electrical energy is 15 kw-hr. The utilization time of the furnace is 71.8%. The brick lining of the charging end of the furnace is distinguished by low durability (6-8 weeks); that of the firing zone has good durability (8-12 months).

At the metallurgical plant in Trzhints, there are four furnaces in operation which take siderite ores from several deposits. The ore is loaded with a crane and bucket into bins situated above the furnaces. The ore is charged from the bins into the furnaces by disk feeders.

The furnaces are fired with a mixture of blast-furnace, coke oven, and natural gases. The calcined ore is cooled asat the plant in Rudnyana with only the exception that several of the furnaces are provided with drum coolers without the planet installation.

After the calcine is cooled, it is fed by conveyors onto the screens. The coarse product is dry ground in ball mills, mixed with the material passing through the screen, and delivered to the magnetic separators. The

degree of communition necessary to free the ore mineral is 2 mm. The ore is beneficiated on dry, "Humbolt"-type separators with a weak magnetic field.

The recovery of iron in the concentrate is 84%. The iron content of the original ore is 27%, and of the concentrate, 49.4%; SiO_2 contents are, respectively, 18.2% and 4.9%.

In contrast to the plant in Rudnyana where fine, classified ore is calcined, ore up to 300 mm in size is received at the plant in Trzhints from several mines. The use of coarse-size ore requires increase in the duration of the calcining process and decreases the durability of the brick lining at the charging end of the furnace (4-8 weeks). Moreover, the comminution equipment is overloaded due to the large, unreacted pieces of ore.

At the plant in Trzhints, the air is very dusty, especially in the screening, grinding, and beneficiation units. The dry dust-removers which were installed have not proved effective in practice. The dust removed from the exit gases is not returned to the furnace, but sent directly to the sintering machines.

Heat consumption per ton of dry ore is 270-280 thousand kcal, and consumption of electrical energy is 9 kw-hr per ton. Idle time is 26.2%. Most of this time is spent in repair of the brick lining.

It must be emphasized that magnetizing calcination was introduced in both Rudnyana and Trzhints on reconstructed, cylindrical sintering furnaces. The necessity of rapidly completing the reconstruction, the lack of industrial experience in calcination, and several other factors did not allow the optimum technological approach or the necessary equipment to be found at once. The experience in magnetizing calcination obtained thus far indicates that it may be expedient to beneficiate the siderite ores. There is no substantial possibility that the performance figures on the magnetizing calcination in the Czechoslovakian Socialist Republic can be improved.

In 1959, investigations on the beneficiation of low-grade oxide and siderite ores from the Telyuk, Gelar, and Yulie deposits were carried out in the Rumanian Peoples' Republic. The results of the beneficiation experiments with these ores is given in Table 2.

TABLE 2

Results of the Beneficiation of Ores by Magnetizing Calcination in the Rumanian People's Republic

Deposit	Chemical composition, %										Ratio of concentration, %	Recovery, %
	of the ore					of the concentrate						
	Fe	SiO_2	CaO + MgO	S	P	Fe	SiO_2	CaO + MgO	S	P		
Telyuk	27–28	15–16	15–16	0,6	0,03	55	8	12	0,4	0,03	40–42	83–85
Gelar	22,0	17,0	19,0	—	—	52–54	10	12–13	0,4	0,08	34	70
Yulie	20,0	31	23	0,07	0,12	40	18	19	0,07	0,12	45	80

Investigations on magnetizing, fluidized-bed calcination are being conducted with the object of developing an efficient method of beneficiation the low-grade, oxide iron ores in the RPR.

Experimental apparatus for the fluidized bed consists of a reactor with a reaction chamber 335 mm in diameter and an arresting zone 600 mm in diameter, a combustion chamber for burning natural gas, an air preheater in which the heat in the exit gases from the reactor is utilized, a cooling device with the fluidized bed, and a control panel. The reactor is provided with a mechanism for distributing the gases in the fluidized bed, a dust removing apparatus, and a device for charging the raw ore.

With this apparatus the mode of calcining an ore consisting of hematite and carbonates was investigated; the effect of preheating the air blast and also cooling of the ore in the fluidized bed with air were studied; the technological parameters of the apparatus itself were worked out and etc. On the basis of the investigations, it is recommended that carbonate iron ore be calcined in a oxidizing atmosphere. The excess of air required for more complete combustion of the fuel does not appear to have an adverse effect on the magnetic properties of the calcined ore.

It has been established that the optimum temperature for calcining carbonate ores is 740°, and the optimum gas flow rate necessary to create the fluidizing bed is 4 m/sec with ore having a particle size of 3mm. Under these conditions, the unit output of the apparatus reached 75 tons/m^2·day with ore particles remaining in the bed an average of 3 min.

The low-grade, hematite ore is calcined in a weakly reducing atmosphere. Calcination of ore 3 mm in size proceeds satisfactorily with a gas flow rate of 2.5 m/sec and the temperature of the process at 740-770°. The unit output of the apparatus under these conditions is 34-37 tons/m^2· day.

During the investigations on cooling the calcined ores in the fluidized bed with air, it was established that the ores under test did not loose their magnetic properties on cooling below 300°. At the present time, experiments are being conducted on lowering still further the cooling temperatures already attained.

The laboratory experiments on burning gas directly in the fluidized bed and preheating the incoming air with the heat in the exit gases have verified the effectiveness of these methods with the experimental apparatus. Moreover, aiming at economy in heat consumption, it is intended to proceed with the design of a multiple-zone, fluidized-bed reactor.

In 1959 in the USSR, a quadruple-zone experimental reactor was built at Krivoi Rog for the fluidized-bed, magnetizing calcination of iron ores; the output of the reactor is 300-350 kg/hr. Beginning adjustments were performed here and a hydrodynamic regime for cold air appropriate to the charge of ore was worked out. On the basis of the data obtained, it may be asserted that multiple-zone, fluidized-bed reactors using classified ore can operate on a continuous schedule and can be automated. Hot tests in this reactor were begun in 1960. It is anticipated that ideal fuel consumption will be reduced one and a half times in comparison with the double-zone reactor.

In 1959, at Krivoi Rog, Mechanobrchermet continued the testing of a shaft furnace 1.05 m in diameter and 6 m high. The uneven descent through the furnace of the material being calcined was successfully smoothed out, and agglomeration was completely avoided in spite of the burning of gas in the ore charge. A constriction, built into the shaft in the burner zone, provided the ultimate solution to the problem of heating the ore clear to the axis of the furnace. However, the cross-sectional temperature distribution in the furnace is still uneven, and this in turn has a negative effect on the quality of the calcination.

The design of the shaft furnace and the technology of calcination in it require work and development.

LOUVER-TYPE DUST-CATCHERS FOR GAS CLEANING

V. D. Kanfer and M. S. Shklyar

Makeevka Metallurgical Factory
Translated from Metallurg, No. 3,
pp. 12-13, March, 1961

Wear of the components of a sintering-machine multicyclone rapidly reduces the efficiency of cleaning of the chimney gases. This reduces the life of the exhauster impellers in addition to leading to a considerable increase in the amount of dust discharged into the atmosphere. As a rule, the life of the components of a multicyclone is 1.5-2.5 years, while general overhaul of the sintering machine is necessary once every 3-5 years. Such a lack of agreement not infrequently necessitates additional stoppages of the sintering machines for the replacement of worn-out components of the multicyclones.

At the sintering plant of the Makeevka Metallurgical Factory, in 1958-1959, a general overhaul of the multicyclones was carried out on two sintering machines in operation. The gases were cleaned out from dust during repair by means of a specially designed, temporary louver-type dust-catcher connected in parallel with the multicyclone undergoing repair*.

*The following took part in the work: M. M. Kotrovskii, B. G. Kumani, S. M. Meerov, V. N. Kriovsheev, A. D. Pleskanovskii, I. E. Zimoglyadov.

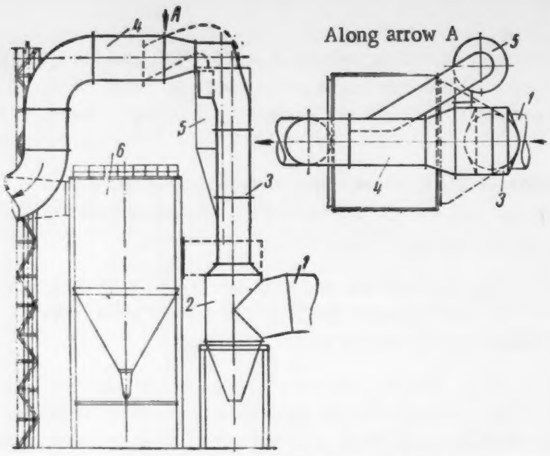

Fig. 1. Louver-type dust-catcher erected in parallel with multicyclone: 1) Manifold; 2) dust settler; 3) louver-type dust-catcher; 4) offtake to exhauster; 5) cyclone; 6) multicyclone.

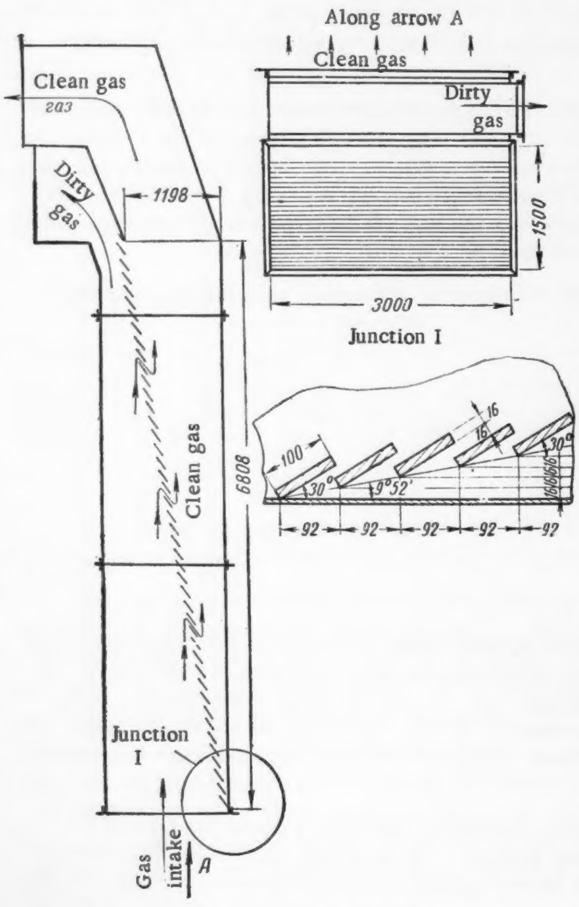

Fig. 2. Diagram of louver-type dust catcher.

Due to a number of advantages (possibility of construction by facilities available at the factory, good cleaning efficiency with long life, and simplicity, compactness, and cheapness of the installation), a louver-type dust catcher on one of the sintering machines was in continuous operation for more than a year.

In connection with the necessity for replacing a cyclone by a multicyclone on one of the sintering machines, a louver-type dust-catcher of improved construction was installed. After the sintering machine had been changed over to the multicyclone, the louver-type dust-catcher was transferred to the other machine, where it was also used during the erection of a multicyclone. When the louver-type dust-catcher was taken down after 4 months of operation, it was found to be in excellent condition. It was decided to use it in future repairs.

Figure 1 shows the louver-type dust-catcher. The gases leaving the sintering machine enter the vertical dust settler, from which they pass directly to the louver-type dust-catcher, situated above the settler. In the dust-catcher the gas is divided into two currents: a dust-free current (80% of the total flow of gas) and a dirty current (about 20% of the gas), in which the main proportion of the dust is consentrated. The clean gas passes through the offtake to the exhauster and the dirty gas to a small special cyclone, where the dust is removed. The gas cleaned in the cyclone is exhausted into the common offtake to the exhauster as result of the combined action of the ejector effect of the main current and the vacuum created by the exhauster.

The total weight of the louver-type dust-catcher is 18 tons (a multicyclone weighs more than 150 tons). The cleaning efficiency of the louver-type dust-catcher is 83-88% (that of a typical multicyclone according to measurement is 80-85%).

Due to considerable wear of the walls of the offtake pipe for the dirty gas and the lower cone of the cyclone, it is necessary to armor them. In louver-type dust-catchers, the dust is separated by the action of the forces of inertia produced on change in the direction of movement of the gas flow about 150°. On its passage through the louver lattice (Fig. 2), the dust-laden gas is divided up into a number of currents equal to the number of gaps between the slats. Due to the inclination of the individual currents to the slats, the bulk of the dust carried by the currents, retaining its original

direction of movement, passes across the gap by inertia and impinges of the surface of the next slat, and being reflected at an angle equal to the angle of incidence, enters the increasingly dust-laden current passing to the cyclone. If a louver-type dust-catcher is used during the repair of a two-battery multicyclone instead of an additional cyclone, one of the batteries of the multicyclone can be used alternately.

The characteristics of the dust-catcher are as follows:

Throughput, m^3/min	3500
Gas velocity, m/sec	20
Resistance, mm water gage	60-70

Louver-type dust-catchers may be recommended as units for the preliminary cleaning of gases (in the design of two-stage gas-cleaning), for example in front of electrostatic filters.

THE USE OF TITANIUM SPONGES IN THE DEOXIDATION OF STEEL

A. N. Vasilyev and S. I. Bogachev

Kuznetsk Metallurgical Combine
Translated from Metallurg, No. 3, pp. 14-16, March, 1961

In making the steels 18KhGT and 30KhGT, titanium sponge in place of ferrotitanium has begun to be used in the single-trough, open-hearth furnaces of the Kuznetsk Metallurgical Combine. Before introducing this measure, a great deal of research work was done on the development of the technical feasibility and economical expediency of such a change.

The experimental heats were conducted according to the plant's technological operating procedures until the moment of final deoxidation. During ordinary heats, the metal was deoxidized in the following manner: when the ladle was 1/5 full of metal, all of the ferrosilicon was added from a stationary bin; and then, ferrotitanium (in pieces 50-180 mm in size) from a cradle on the overhead crane was added. Charging of the deoxidizers was complete by the time the ladle was 3/4 full.

Ferrotitanium, the consumption of which was 2000 kg per heat, contained on the average 27% Ti and 8.5% Al. During several heats, the ferrotitanium was not charged evenly, and the large pieces did not dissolve before the appearance of the slag; this led to saturation of the surface layer of metal and reduction of manganese and silicon from the slag.

Consequently, from each heat one or two of the ingots teemed last were rejected, since their content of manganese and silicon was higher than stipulated in the technical specifications. The quantity of ingots rejected on the basis of chemical composition was about 2.0%.

In the experimental heats, the sequence of charging the deoxidizers into the ladle was the same as usual. The only difference was that instead of ferrotitanium, aluminum (410 g/ton) and a quantity of titanium sponge amounting to approximately 600 kg per heat (3.2 kg/ton) were added to the ladle. Two types of titanium sponge were used: "screenings" in pieces 10-50 mm in size and with a specific gravity of 3.8 g/cm^3 and "tails" with a planar dimension up to 100 mm, a thickness up to 5 mm, and a specific gravity of 2.6 g/cm^3.

The chemical composition (%) of the titanium sponge is as follows:

	Ti	Fe	C	Si	Mn,P, S
1. Screenings	98.5	1.4	0.05	0.05	trace
2. Tails	99.4	0.5	0.05	0.05	"

The titanium sponge should be kept in covered metal containers, since instances were noted where it was ignited by falling sparks.

Ninteen experimental heats of the 18KhGT steel and one of the 30KhST steel were made using titanium sponge. As a comparison, data was used from 11 ordinary heats made in 1959 in which ferrotitanium was added to the ladle and which were teemed through sleeves 45 mm in diameter, filling the molds at a rate of 2.6 tons per min.

The results of testing the uniform distribution of the elements (Table 1) showed that manganese and silicon are evenly dispersed throughout the metal from the beginning to the end of the cast; significant deviations from homogeneous composition (the intermediate ingots) were not observed; the metal met the requirements of technical specifications. The maximum difference in content of the elements from various assays of the heats was in titanium 0.02%, in manganese 0.06%, and in silicon 0.04%.

TABLE 1

The Distribution of the Elements in Assays of the Metal from 11 Experimental Heats

Heat	No. of ingots	Chemical composition, %			Heat	No. of ingots	Chemical composition, %		
		Mn	Si	Ti			Mn	Si	Ti
7-4562	2	0,92	0.27	0.12	7-4640	2	0,87	0,28	0,11
	14	0,93	0.27	0,12		15	0,85	0,27	0,11
	31	0,91	0.25	0,12		31	0,85	0,28	0,11
	32	0.86	0,24	0,12					
9-4284	2	0,96	0,29	0.11	7-4633	2	0,84	0,23	0.09
	14	0,97	0.29	0,11		15	0,86	0,23	0,08
	31	0.93	0,30	0,11		30	0,82	0,25	0,08
	32	0,91	0,30	0,11		31	0,84	0,22	0,08
10-4411	2	0,90	0,27	0,10	7-4623	2	0,84	0.20	0,08
	13	0,87	0,28	0,10		14	0,84	0.20	0,08
	34	0,89	0,28	0,10		28	0,85	0.20	0,08
						29	0,82	0,19	0,08
9-4354	2	0,86	0.26	0,10	9-4286	2	0.86	0,24	0,12
	12	0,85	0,29	0,10		15	0,92	0,24	0,12
	23	0,86	0,28	0,08		32	0,86	0,24	0,12
	24	0,88	0,30	0,08					
7-4648	2	0,92	0,30	0.12	10-4348	2	0,90	0,24	0,10
	14	0,91	0,30	0.12		14	0,88	0.27	0,09
	28	0,88	0,30	0,12		28	0,88	0,24	0,10
	29	0,91	0,31	0,12		30	0,88	0,24	0,10
10-4334	2	0,88	0,23	0,10					
	15	0,88	0,27	0,09					
	24	0,84	0.23	0,10					
	32	0,84	0,23	0,10					

TABLE 2

Results of Mechanical Testing

Heats	No. of heats	Yield strength, kg/mm²	Yield point, kg/mm²	Percent elongation	Percent reduction in area	Toughness, kg · m/cm²
Specified	—	100	Not less than 90	9	50	8
Experimental	19	110.4	108.4	12.5	61.9	12.7
Ordinary	11	106.0	103.0	13.2	63.0	14.0

In order to decrease the chemical reaction between titanium in the metal and the oxides of silicon and manganese in the slag, 300 kg of finely divided lime was added to the ladle upon the appearance of the slag in the experimental heats and 400 kg in ordinary heats.

The smaller amount of ferroalloys added to the ladle (a reduction of approximately 1100 kg) in the experimental heats permitted deoxidation at a temperature lower than in ordinary heats. In spite of the comparatively low temperature of the metal and the smaller input of lime for slag formation, none of the ingots from the experimental heats were rejected on the basis of chemical composition; in ordinary heats, on the other hand, ingots with satisfactory chemical composition were obtained every three heats (27%).

The macrostructure of samples taken from the leading bars of both the experimental and ordinary heats is unsatisfactory, but it is better in those from the heats using titanium sponge. The quantity of samples with unsatisfactory macrostructure from heats using titanium sponge was 23.2%, as compared to 32.2% from the ordinary heats.

It had previously been established that the macrostructure of 18KhGT steel is significantly impaired by lowering the temperature of the metal before deoxidation. In both the experimental and ordinary heats, the number of templets rejected on the basis of macrostructure was less in heats where the temperature before deoxidation was 1650-1660° than in those where it was 1625-1645°. In the group of experimental heats where the temperature before deoxidation was low (1625-1645°), the number rejected templets was 24.7%, which is less than the number rejected from the group of ordinary heats with the same temperature by 18.3%. This can be explained by the fact that in the heats with titanium sponge, the quantity of deoxidizers added to the ladle was less than in ordinary heats by 1100 kg, and the metal was teemed faster (55 mm sleeve).

During the course of the investigation, it was also established that when the weight of the ingots is increased from 6 to 7 tons, the macrostructure of rolled stock becomes worse, especially in the presence of impurities. Due to less chilling of the metal in the ladle and faster teeming, the rolled stock from the experimental heats showed less impairment of the macrostructure when the weight of the ingots was increased.

The mechanical properties of the rolled stock (80-130 mm in circumference) was kept within specifications (Table 2).

Metal from the experimental heats is distinguished by higher strength characteristics. Both groups exceed the demands of technical specifications in all mechanical tests. The surface qualitv of the ingots and the quality of the finished product are nearly identical for experimental and ordinary heats.

Table 3 records the consumption of deoxidizers and alloying elements added to the ladle during the manufacture of 18KhGT steel. In the experimental heats, the quantity of materials added to the ladle was reduced by 1115 kg, the input of titanium containing materials was decreased by 1380 kg, the input of ferrosilicon was increased by 185 kg, and that of aluminium was increased by 80 kg.

TABLE 3

Consumption of Deoxidizers

Deoxidizers	Ordinary heats (11 heats)					Experimental heats (11 heats)				
	added to the ladle, kg	contained in the final steel, %		loss, %		added to the ladle, kg	contained in the final steel, %		loss, %	
		Ti	Si	Ti	Si		Ti	Si	Ti	Si
45% FeSi.	305	—	0,29	—	9,3	490	—	0,27	—	17,0
Aluminum.	—	—	—	—	—	80	—	—	—	—
Ferrotitanium . .	2000	0,098	—	64,2	—	—	—	—	—	—
Titanium sponge	—	—	—	—	—	620	0,104	—	66,8	—
Total.	2305	0,098	0,29	64,2	9,3	1190	0,104	0,27	66,8	17,0

The loss of titanium and silicon was increased by 2.6% and 7.7%, respectively, in the experimental heats. Considering the plant's cost of deoxidizers and alloying elements, the use of titanium sponge in place of ferrotitanium was found economically expedient.

The economical result of changing from ferrotitanium to titanium sponge amounts to 48 kopeks per ton of steel, not counting the saving in avoiding the rejection of the last-teemed ingots because of unsatisfactory chemical composition.

On the basis of the tests conducted and the practical utilization of titanium sponge, the following conclusions may be drawn:

(1) Changing from ferrotitanium to titanium sponge does not occasion technological difficulties and ensures a homogeneous composition of the steel;
(2) Titanium sponge dissolves in the ladle better than does ferrotitanium, eliminating rejection of individual ingots on the basis of chemical composition;
(3) Quality characteristics of the metal produced using titanium sponge are essentially no different from those of the metal in which ferrotitanium was used;
(4) The use of titanium sponge permits a saving of approximately 50 kopeks per ton of steel produced;
(5) In order to avoid ignition of the titanium sponge, it should be stored and transported in covered metal containers.

TREATMENT OF LIQUID STEEL WITH SOLID SYNTHETIC MIXTURES

V. A. Kudrin, E. V. Vinnichenko, G. V. Sviderskii, V. P. Tunkov, and O. N. Sokolov

Moscow Steel Institute and "Serp i Molet" plant

Translated from Metallurg, No. 3, pp. 16-17, March, 1961

With the object of elucidating the possibility and advantages or treating steel with solid synthetic mixtures, a series of experimental heats were made in the furnaces of one of the open-hearth shops of the "Serp i Molet" plant. On the basis of available published data and the results of the first production trials, a desulfurizing mixture having the following percentage composition was selected:

Freshly burnt lime	70-75
Flurospar	25-28
Granulated aluminum	0-4

The consumption of mixture was 8-11 kg/t of steel. The components of the mixture were crushed manually, the fluorspar being heated up preliminary in a charging box. The mixture was fed to the stream of metal on tapping the furnace partly from a hopper with 45% ferrosilicon and partly by hand. In each experimental heat, samples of steel were taken for chemical analysis from the furnace immediately before tapping and in the middle of pouring.

As will be seen from the data of Table 1, the average drop in sulfur content after treatment of the metal with the synthetic mixture was 28% relative to the sulfur content before treatment with a mixture.

TABLE 1

Results of Chemical Analysis of Samples and Degree of Desulfurization

No. of heat	Steel	Content, % C	Content, % Mn	Content, % P	S content, % before treatment	S content, % after treatment	Degree of desulfurization, %
54468	U12A	1,22	0,18	0,008	0,027	0,018	33,4
54477	U8A	0,87	0,26	0,008	0,020	0,015	25,0
54528	U8A	0,85	0,24	0,010	0,020	0,012	40,0
54577	U8A	0,85	0,25	0,010	0,024	0,018	25,0
63109	U8A	0,72	0,23	0,010	0,025	0,018	25,0
63135	U10A	0,95	0,19	0,010	0,028	0,020	28,6
54697	St 5	0,37	0,56	0,010	0,030	0,023	23,4
54700	U12A	1,15	0,20	0,010	0,024	0,018	25,0
54761	20	0,17	0,40	0,012	0,030	0,024	20,0
54777	20	0,18	0,47	0,012	0,037	0,030	19,0
54804	20	0,17	0,65	0,016	0,037	0,025	32,4
54808	40	0,39	0,34	0,018	0,038	0,026	31,6
63257	U8A	0,82	0,18	0,010	0,030	0,019	36,8
63262	20	0,23	0,54	0,010	0,036	0,028	22,8

The desulfurizing process is somewhat more intense with a high carbon content. Thus, the average desulfurization figure for eight heats of steel U8A-U12A was 30%, while in the case of heats of steels 20-40, this value was 25%.

An analysis of the results of the experiments (by the method of electrolytic solution) showed that the content of nonmetallic inclusions in the steel, with and without treatment with the mixtures, is the same. No CaO was found in the inclusions.

Analysis of the steel of the experimental heats for hydrogen as a function of the moisture content of the mixture (samples taken from the top part of the crystallizing ingot and subsequent analysis by the method of heating in a vacuum) showed that insignificant moisture content of the mixture (up to 1.5% H_2O) has practically no influence on the hydrogen content of the steel.

Table 2 gives the mean results of the mechanical tests of steel from the experimental heats (steel 20).

In the treatment of high-grade tool steel with synthetic mixtures, the output of the open-hearth furnace can be increased by 10-15%, due to the shortening of the boiling period, essential for ensuring the necessary desulfurization of the metal when melting by the usual process. The cost of the steel (for a cost of the mixture of about 25 kopeks per ton) is correspondingly reduced by 2-2.5%.

TABLE 2
Mechanical Properties of the Steel

Heats	Ultimate strength, kg/mm²	Yield strength, kg/mm²	Elongation, %	Reduction of area, %
Treated with mixture . . .	48.1	38.0	31.4	63.2
Without Treatment	48.2	36.0	29.4	59.6

The use of the different compositions of desulfurizing mixtures given at the commencement of this for reasons of safe working.

The degree of desulfurization (20-40% relative to the sulfur content before tapping the heat) depends little on the sulfur content before treatment in the ladle. It should be noted that the degree of desulfurization is reduced (to 20%) if the heat is tapped with the temperature of the metal at the lower limit for the given steel.

To obviate the possibility of metal being ejected from the ladle if individual components having a high moisture content accidentally find their way into the mixture, the mixture must be fed to the stream of metal only. The feeding of the mixture should be commenced after about one quarter of the entire heat has been run into the ladle, and it should be completed before the appearance of the slag. The mixture should not be fed on to the bottom of the ladle before tapping the heat for reasons of safe working.

NICKEL ECONOMY IN ELECTRIC STEEL-MAKING PRODUCTION

Deputy Chief Engineers A. F. Kablukovskii
and A. A. Pankratov

Élektrostal' Factory
Translated from Metallurg, No. 3,
pp. 17-22, March, 1961

Constructional, acid-resistant, high temperature, nonmagnetic, and other steels and alloys contain nickel in the range 1-80%.

Alloying constructional steels with nickel considerably raises their toughness and plasticity. Introducing nickel (up to 12%) into chromium stainless steel increases its resistance to corrosion. With large nickel contents the physical properties of steels and alloys are considerably altered, magnetic permeability is raised, and the electrical resistance, the scaling resistance, and the resistance to loads during the prolomged working of components at high temperatures are increased.

The wide use of nickel steels in different sectors of the national economy requires the most rational and economic utilization of nickel in electric steel production. In the Élektrostal' factory, a series of measures for saving nickel has been implemented in the smelting of steels and alloys in arc and induction electric furnaces. These are:

remelting alloyed scrap in electric arc furnaces with the use of oxygen;
improving the melting technique;
the production of replacement steels containing little nickel;
the electroslag method of obtaining ingots;
the protection of the liquid metal from oxidation during pouring;
making use of alloyed scrap;
the collection and use of nickel-containing powder from grinding.

In melting stainless steel 1Kh18N9T with oxygen, the melt duration is markedly shortened and rejects and specific consumption of electric energy are reduced. This method has gained widespread application in the production of other alloyed steels, since it is possible to use up to 80% scrap in the charge. In 1960, more than 66% of the steel was smelted with oxygen.

The melting of steel 1Kh18N9T in the electric arc furnaces of the Élektrostal' factory by the method of remelting alloyed scrap with oxygen has the following features; namely, that 100% alloyed scrap may be used in the charge, and the amount of turnings in the charge composition is not limited and is determined only by economic considerations and the necessity of charging everything in one or two lots (without additional charging operations after the partial melting down of the charge).

The rated carbon content in the charge should be not less than 0.15% above the lower limit for the mark of steel being smelted. A higher carbon content in the metal at melt-down does not appreciably prolong the melt, since oxidation of carbon and the bath boil are begun at a lower temperature.

The rated silicon content in the charge for the normal course of the oxygen blow should be in the range 0.8-1.0%.

Placing slag-formers (fluorspar, lime, etc.) in the furnace before charging is not carried out.

It is recommended that the oxygen blow to speed up the melting of the charge should be started with unlined tubes 55-65 min after switching on the current, when there is still much unmelted charge in the furnace. For blowing to oxidize the bath, a water-cooled lance is used which is introduced into the working volume of the furnace through an aperture in the roof. At the end of the oxidizing blow, all the ferrochromium calculated to be necessary is added into the furnace. The use of oxygen to accelerate the melting of the ferrochromium is not permitted.

For fluidity and to reduce chromium from oxides, the slag is deoxidized in the reducing period with 15-25 kg/ton silicochromium (33% Cr and 50% Si), or with 45% FeSi in 10-20 mm pieces.

The temperature of the metal in the ladle should be, according to an immersion thermocouple, in the range 1550-1600° C.

TABLE 1

Details of Melting Steel 1Kh18N9T

Detail	Year				
	1956	1957	1958	1959	1st quarter 1960
Metal rejected, % of ingots cast	0.7	1.3	1.1	0.8	0.7
Use of alloyed scrap, % of charge	54.8	56.0	57.5	49.8	49.4
Consumption of fresh nickel, kg per ton of serviceable ingots	9.4	9.4	5.8	7.4	7.1

The metal is bottom-poured into round cast-iron ingot-molds, (without greasing) to give ingots weighing 500 kg or more. They are filled up to the hot-top as fast as possible, and the hot-top is slowly filled. The total time taken in filling a 4-8 place mold-assembly is in the range 80-100 sec. The ingots cool in the ingot-molds for not less than one hour.

The chromium content in the finished metal should be in the range 17.0-18.0%, and the nickel content 9.0-9.5% (for sheet) and 10.2-11.0% (for tubes).

The average time taken in melting steel 1Kh18N9T with oxygen in 20-ton arc furnaces is 2.7-3.0 hours.

Technical and economic details of electric melting with oxygen are set out in Table 1.

A certain reduction in the percentage use of scrap does not lead to an increase in the consumption of fresh nickel per ton of serviceable ingots, since the scrap contains more nickel than that required in steel 1Kh18N9T. Remelting mixed nickel-containing scrap makes it possible to standardize the charge-calculation to conform to the rated chromium and nickel contents, and guarantees an exact hit within narrow limits of chemical composition with the minimum consumption of nickel.

To replace costly lead apparatus, the chemical industry is making wider use of chromium-nickel-molybdenum-copper steel type ÉI629 containing not more than 0.10% C, 1.0% Si, 1% Mn, 0.02% S, 0.03% P, 17.0-19.5% Cr, 27.0-30.0% Ni, 2.5-3.5% Mo, 3.5-4.5% Cu, and not more than 0.7% Ti. Smelting complex alloyed steel from a fresh charge with a boil was accompanied by high rejection of metal, because transverse cracks and fissures occurred in forging 500 kg ingots into square or round section billets. In order to increase the yield of serviceable material, to reduce rejects, and to save nickel and copper, the smelting technique for chromium-

nickel-copper steel was improved. The typical features of the melting of acid-resistant steel are—a) the melting together of ferrochromium, nickel, ferromolybdenum, and copper with armco iron and scrap; b) thorough deoxidation of the bath in the reducing period of the melt with silicocalcium and metallic calcium; c) the narrow temperature range for the metal in the ladle after pouring; d) casting the steel into ingots only by bottom-pouring.

TABLE 2

Smelting Details for Acid-Resistant Steel

Detail	Year			
	1957	1958	1959	6 months, 1960
Scrap used % of charge . . .	–	–	21.8	36.8
Consumption, Kg per ton of serviceable ingots,				
of nickel	376.1	291.4	245.0	217.0
of copper	42.7	40.6	30.6	27.0
Metal rejected, % of ingots cast	11.9	15.0	3.1	2.0

Smelting acid-resistant steel with the new technique made it possible to reduce rejection of metal because of transverse cracks occuring during the forging of ingots into billet by a factor of almost five, to increase the yield of serviceable material considerably, and to reduce the consumption of nickel and copper per ton of serviceable ingots (Table 2).

To prevent acid-resistant steel scrap accumulating in factories in the form of sheet shearings and turnings, it is feasible in using oxygen to increase the amount of scrap in the charge to 50-55%. The introduction of the advanced smelting technique with oxygen and the thorough deoxidation of the bath with active metals and alloys (calcium and silicocalcium) in high-grade metallurgical factories, has made it possible to save a considerable amount of nickel and copper for the national economy.

In the near future, replacement stainless steels with high manganese and nitrogen contents will obtain wide use in industry. The typical chemical composition of these steels is up to 0.1% C, up to 0.8% Si, 4.0-6.0% Mn, not more than 0.03% S, not more than 0.035% P, 17.0-20.0% Cr, 1.5-2.5% Ni, and 0.15-0.20% N.

Chromium-manganese steel with nitrogen is smelted in induction and arc furnaces with basic refractory lining. The charge consists of scrap of the steel to be smelted, soft iron with a carbon content up to 0.05%, nitrogen-containing ferrochromium, and nickel. To obtain the necessary manganese content, metallic manganese is introduced at the end of the melting period. The rated manganese content in the charge varies in the range 5.5-5.8%. To reduce chromium and manganese losses in the melting period, the slag is deoxidized with silicocalcium powder (5-6 kg/ton). The temperature of the liquid steel at melt down should be in the range 1520-1550° C.

In the arc furnace the reducing period is carried out under a white slag. The slag is deoxidized with crushed coke (2-3 kg/ton) and silicocalcium powder (3-5 kg/ton). In the induction furnace the slag is deoxidized with a mixture of aluminum powder and lime. Fifteen to 20 minutes before pouring the melt, metallic calcium (1 kg/ton) is introduced into the bath on a bar. Ten minutes before pouring, a nickel-manganese master alloy is added to the metal at a rate to give a manganese content 0.05% above the upper limit (without taking losses into account). The temperature of the metal in the furnace before pouring should be in the range 1500-1520°C. The metal is bottom-poured into round ingot-molds to give ingots of 500 kg or more. To obtain a second ingot, it is recommended to have in the final metal a nitrogen content near to the lower limit, and manganese, chromium, and carbon contents near to their upper limits. After being stripped and cooled down, the ingots undergo skimming.

The melting technique which has been presented ensures continuous yield of serviceable metal with 55-60% conversion into billet. Replacement of stainless steel 1Kh18N9T by manganese steel containing nitrogen, with identical properties, makes it possible to save up to 70 kg of nickel in each ton of serviceable rolled product.

A large source for the saving of nickel is the further improvement in the quality of nickel steels and an increase in the durability of components, machines, and mechanisms. For these purposes there is considerable interest in the method developed by the E. O. Paton Institute of Electric Welding. This method of obtaining high-quality metal is new in principle and consists in the electroslag remelting of consumable electrodes of the same composition in a water-cooled copper mold. The melting of the electrode takes place not by means of an electric arc, but by the heat developed in a layer of molten slag acting as a resistance during the passage of the electric current through it.

The electroslag installation (Fig. 1) consists of a copper water-cooled mold, a copper bottom-plate and an electrode column with grip support. In working, round, molds of various cross sections (180-420 mm) are used. The diameter of the consumable electrodes is 80-300 mm. In order to make more complete use of them, steel rods are welded to the electrode tops, and these are gripped in the support. Two types of flux are used for working: the working flux in the majority of cases is mark ANF-6, containing about 60% CaF_2, 30-38% Al_2O_3, 3-6% CaO, up to 2% SiO_2, and not more than 1% MgO and Fe_2O_3; to start the electroslag process, a flux conducting in the solid state is used, which consists of a mixture of aluminum-magnesium powder PAM-3 with the working flux.

Before the start of melting, a steel primer is set on the bottom plate in the form of a plate onto which about 400 g of the conductiong flux is deposited: the mold and electrode are lowered until they touch the flux. Working flux is charged into the gap between mold and electrode and the current is switched on. In the electroslag process, the necessary conditions are created for obtaining ingots with a dense cast structure, for ridding the metal of a number of harmful impurities and nonmetallic inclusions, and for reducing segregation phenomena. Ingots made by the electroslag method differ from ordinary ingots in the great homogeneity of their chemical composition, their dense macrostructure, the absence of shrinkage cavities and porosity, the absence of blisters beneath the crust, axial porosity and other defects due to shrinkage or segregation, and their high purity as regards nonmetallic inclusions (the contamination of the metal is reduced by a factor of 2-5). Usually, cast, forged, and rolled rods of metal melted in induction and electric arc furnaces are used as the consumable electrodes.

With the aim of saving nickel, bars of final rolled product rejected for surface defects, nonmetallic inclusions, and other causes are used for the consumable electrodes. Remelting rejected bars of type KhI7N2 steel makes it possible to obtain high-quality ingots and forgings without internal defects detectable in the components by the ultrasonic method. The rejection of polished stainless sheet of steel Kh18N9 at the customer factory has been reduced by a factor of 3-5 after preparing the metal by the electroslag method. Further growth of the electroslag method of obtaining ingots will make it possible to increase considerably the yield of material acceptable to the customer and by this means to save hundreds of tons of nickel.

In casting titanium-containing chromium-nickel steel in air, the undercrust layer of the ingots is always affected to a large depth by so-called titanium porosity, which shows itself as a mass of crystallized titanium oxides and nitrides of complex composition. The defective surface zone on the ingots is removed by skimming. To reduce metal lost as turnings during the skimming, special vacuum-argon chambers have been used (Fig. 2).

TABLE 3

Details of Casting Metal in Air and in an Argon Atmosphere

Mark of steel	Method of casting	No. of melts	Metal lost in skimming, kg/ton	Ni saving, kg/ton	Savings, rubles per ton; including mold assembly and argon
A	in air	18	172		
	in argon	25	138	34	420
B	in air	15	183		
	in argon	20	126	57	480

The installation makes it possible to top- or bottom-pour large and small ingots in an evacuated space or in an inert-gas atmosphere; namely, argon. Welded from iron sheet, the chamber consists of two parts: a fixed base (the bottom) and a hood which can be raised. In bottom-pouring, on the bottom of the chamber a bottom-plate, ingot-molds, runners, and a fountain are set up. The chamber with an aperture for the metal stream and two or three inspection windows for control over the casting of the metal is lowered onto the rubber vacuum seal set in grooves in the bottom. Before casting, air is removed from the chamber through outlet tubes by the vacuum pumps down to a residual pressure not greater than 1 mmHg. The ladle with the metal is set up in guides on the upper part of the hood, so that the axis of the ladle socket coincides with the aperture for the metal stream, the aperture being covered with an aluminum sheet after evacuation and before casting in an inert-gas atmosphere, the chamber is filled with argon, supplied through a special valve from the cylinder.

Casting steel in vacuum and in an inert-gas atmosphere considerably improves the surface of ingots, reduces the depth of skimming, raises the yield of serviceable rolled material, and reduces the consumption of nickel. The technical and economic advantages of casting certain marks of steel in vacuum-argon chambers are set out in Table 3.

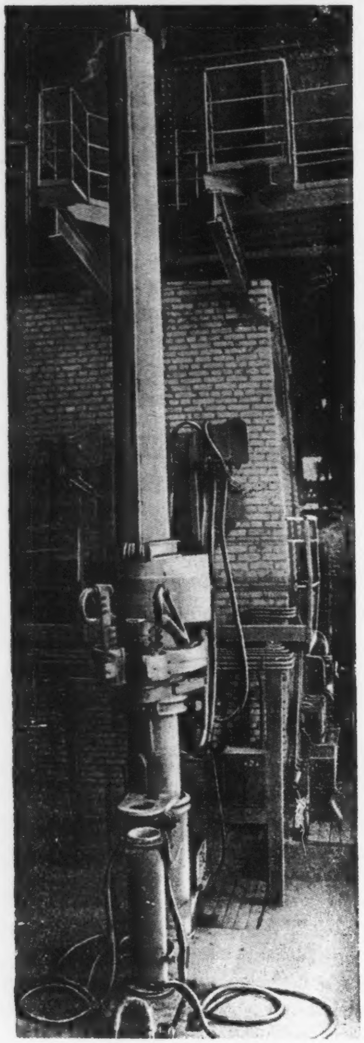

Fig. 1. The electroslag installation.

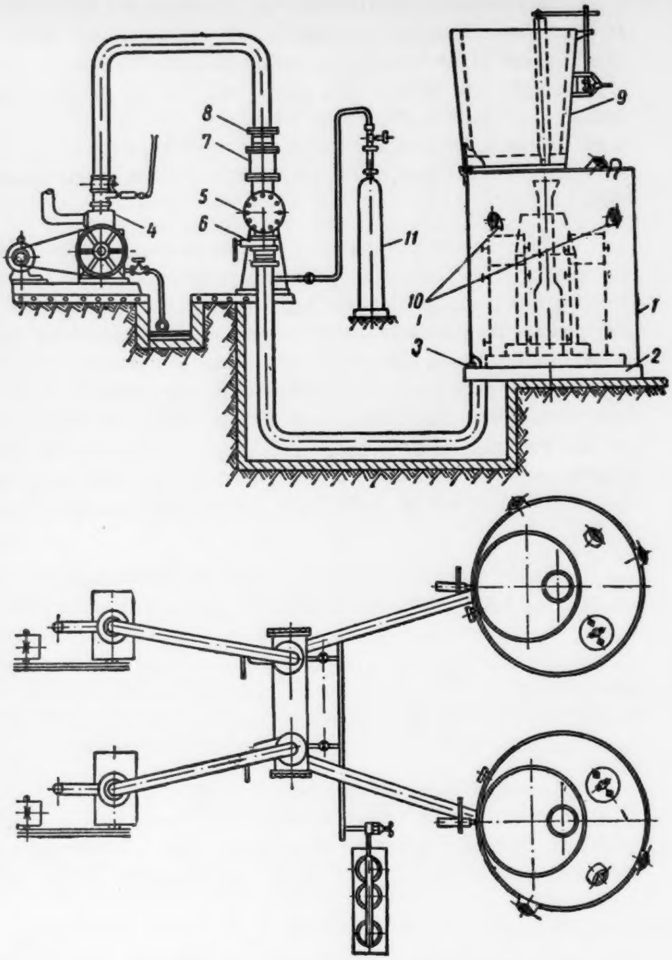

Fig. 2. Diagram of an installation for casting steel and alloys in vacuum and in inert-gas atmosphere. 1) Hood ; 2) support plate ; 3) rubber gasket ; 4) vacuum pum= ; 5) filter-collector ; 6) slide valve ; 7) filters ; 8) flexible bellows ; 9) steel pouring ladle ; 10) observation windows ; 11) inert-gas cylinders.

After pouring the melt, the refractory lining of the arc furnace is cleaned of remaining slag and metal. Solidified slag from slag pots together with alloyed scrap and "buttons" of metal were formerly knocked out into dumping wagons and dispatched to the slag dump. At the present time the crushing of slag under a drop hammer and the sorting out of extracted metal have been organized. The metal extracted is remelted in arc furnaces into pig and is used in smelting nickel steels. By the extraction and use of alloyed scrap from slag in 1960, about 130 tons of nickel was saved.

Surface defects on forged and rolled metal of highly alloyed marks of steel are removed by cleaning-up with abrasive wheels in grinding machines. Grinding powder formed in cleaning-up the metal contains (depending on the mark of steel being treated) up to 8-12% nickel. To collect and use the grinding powder in the production of nickel, all the machines are equipped with suction ventilation. The metal grinding powder proceeds from the machines along tubes into special reservoirs, where it accumulates. After control analyses for the nickel content, the grinding powder is loaded into wagons and dispatched to factories for reworking. The amount of grinding powder dispatched, on conversion into nickel, is annually 450-500 tons. The collection and use of grinding dust for the extraction of nickel makes it possible to increase the production of nickel steels considerably.

The measures which have been described make it possible for the factory to save a considerable amount of nickel each year in the melting of electric steels.

THE RAPID BURNING-IN OF NEW HEARTHS

V. K. Laptev

Azerbaidzhan Tube-Rolling Factory

Translated from Metallurg, No. 3,
pp. 22-23, March, 1961

In recent years the technique of hearth running repairs has undergone considerable changes, but new hearths are still burned-in with the old method—in thin layers with prolonged baking of each layer.

In our factory new hearths were, as a rule, burned-in in twelve layers, each layer baked for 7-8 hours (the total time taken in burning-in was about 100 hours). This was explained by the deeply inrooted opinion that the whole mass of the magnesite should be carefully baked in.

In working with magnesite-chrome roofs, the furnace heat power has increased considerably: therefore, burning-in new hearths in thin layers with prolonged baking leads to this; the slag melts and, penetrating into the lower layers of the burned-in hearth, enriches them. On the other hand, the upper layers are denuded of slag, and become "dry," "over-roasted," because of which the magnesite grains are imperfectly welded together. This sometimes leads to the breakdown of the burned-in lining in the first melts.

Our factory, having made use of the experience of other undertakings, has developed a technique suitable to the local conditions, of burning-in hearths in thick layers, each layer being treated with furnace scale. In burning-in and repairing hearths, the forming of the layer being burned-in is completed in burning-in subsequent layers, and consequently there is no possibility of finishing off the complete welding of each layer in the process of baking it. It is adequate to ensure that the grains of magnesite powder are held in the layer.

The new technique has considerably shortened the time taken in burning-in: whereas with the old technique, burning-in the hearth of one furnace took 95 hr 05 min, with the new technique in burning-in the hearths of two furnaces 40 hr 30 min and 33 hr 20 min, respectively, were required. The hearths were burned-in in four layers, the thickness of each layer being 50 mm.

Below is described the burning-in of the hearth in two furnaces of medium capacity with chrome-magnesite roofs, working on natural gas with fuel oil carburetion. For starting the slagging-off, the furnaces were well heated (the roof temperature was 1800° C; regenerator temperature, 1250° C)*.

To slag-off the lining, a mixture consisting of 50% ground slag and 50% furnace scale was used. The mixture was thrown in through all the doors onto the hearth, slopes, front and rear walls. When a slag pool 80-100 mm deep had formed on the hearth, it was splashed with special rabbles onto the slopes and onto the front and rear walls. After holding for an hour, the remaining slag was poured off from the furnace into a slag pan. In slagging-off, which lasted about 5 hours, 13 tons of mixture was used.

The hearths were burned-in with pure magnesite powder, which had been riddled through an 8-mm-aperture sieve, the fine fraction not being sieved off. After the magnesite powder had been uniformly scattered, the hearth was baked for 4-6 hours, then the layer was treated with furnace scale, at the rate of about 20-25% of the magnesite powder consumption, with subsequent baking for 1.5-2 hours. The constructional shaping of the angles of inclination of the hearth and slopes was begun in burning-in the first layer.

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* The hearth was built up by Chief Foremen I. I. Nabiev and V. M. Katykhin under the direction of P. P. Podgornii; the building-up technique was controlled by O. I. Sarkisova, T. K. Khateeva, M. V. Chubko, and T. M. Torunova.

Before adding each subsequent layer, a sample of the burned-in hearth was taken. The layer was considered to be thoroughly burned-in if the sample did not disintegrate after cooling in air. The samples taken back were black in color with a brown tinge; and in the fractures the different grains of magnesite were hardly visible.

In connection with the use of furnace scale in burning-in hearths, the ferrous oxide content increased considerably and the magnesite content was somewhat reduced: however, as experience has shown, this had no effect on hearth life. After burning-in, the hearth is cooled during 12-15 min and the introduction of the charge is begun. The first melts went well, without breakdown of the burned-in lining, with fluid slags, and subsequently the condition of the hearths has also been good.

In both furnaces the life of hearths burned-in with the new technique has turned out to be longer than in hearths burned-in with the old technique.

In this way, the use of the new technique gives a considerable advantage in time (2-3 days) and ensures high quality in burning-in new hearths.

Each year the team of Communist labor of the blast-furnace workers of the Zakavkazsk Metallurgical Factory, led by Archil Dzamashvili, Hero of Socialist Labor, gives hundreds of tons of pig-iron more than planned. All the members of this team play their part. Archil Dzamashvili himself is a student of Course IV of the V. I. Lenin Gruzniskii Polytechnic Institute. In the photograph: Archil Dzamashvili (in center) with members of his team.

Cherepovetsk Metallurgical Factory. Workers of the blast-furnace shop, who have achieved the high status of Collective of Communist Labor (from the left): Furnaceman M. F. Gusev, Furnace Foreman F. F. Smirnov, Furnace Chief A. Ya. Kiselev, Furnaceman Yu. D. Smirnov, Water-Supply Fitter F. Ya. Tsvetkov, and Furnaceman A. I. Gutorov.

TASS photograph

Senior Groove Designer B. M. Ilyukovich

Chusovoi Metallurgical Plant
Translataed from Metallurg, No. 3,
pp. 24-26, March, 1961

Having taken into consideration the demand of the economy for light economical shapes, the new All-Union State Standard provided for rolling of L-shaped steel with leg widths of 25 x 16-250 x 160 mm and thicknesses 3-20 mm, and the total number of shape sizes was increased from 43 to 53 (All-Union State Standard 8510-57). The savings in metal in this case is about 5%.

The ratio of the leg widths according to the new All-Union State Standard is within narrower limits, being 1.5-1.64 instead of 1.34-1.75 according to the old standard. This makes it possible to use the same rolls of the finishing stand for proximate shapes with a different thickness of widths of the legs.

The specific gravity of the shape sizes of angle steel with leg thicknesses up to 8 mm, inclusive, increased from 44 to 66%. This resulted in additional difficulties in mastering and subsequent rolling.

Angle steel 90 x 56 x 6-8 mm and 80 x 50 x 6 mm is rolled on the 550-three-stand mill in line at the Chusovoi Metallurgical Plant.

Figure 1 shows the pass templets for rolling angle of 80 x 50 x 6 mm; the total number of passes is 11. A 120-mm square serves as the starting bloom. The cross section of the bloom being delivered to the fifth groove should be 81 x 82 mm.

The rolls of the blooming mill are type-70 steel castings; cast-iron semihard low-alloy rolls modified by magnesium are used on the roughing and finishing stands.

The experience of rolling L-shaped steel at the Chusovoi Metallurgical Plant provided the expediency of using B. P. Bakhtinov's method for calculating the grooving. The best results are obtained by using this method, and it is possible to roll shapes of different thicknesses in the same grooves, which were designed with a crowded spread for the minimum thickness taken into consideration. Thus, on the 550-mill, angle steel 90 x 56 mm with thicknesses of 6 and 8 mm is rolled in the grooves to a thickness of 6 mm, which cuts down roll-changing time. A change in the length of the legs with an increase in thickness of the angle is eliminated by adjustment. After changing the rolls, rolling should commence from the minimum thickness of the angle steel in order to avoid roll marks.

The grooves were constructed with a constant radius of the contour of the upper line of the legs and with a decrease in the apex angle in each subsequent pass equal to half the magnitude of reduction. The grooves are arranged in such a manner that their natural line passing through the center of gravity coincided with the middle lines of the rolls. The calculated spread differs from the actual, and on the finished shape the larger leg becomes long and the smaller leg becomes short.

The following method of distributing the spread can be recommended for L-shaped steel.

1. The total spread, which is calculated by B. P. Bakhtinov's formula, for closed passes with consideration of the degree of hindrance is distributed in proportion to the middle leg lines of the grooves. In order to simplify the calculation, the ratio of the middle lines of the legs of all grooves can be identical and correspond to the finished shape.

2. Displacement of the apex axis is taken into account, and this displacement must be added to the spread of the long leg and subtracted from the spread of the short leg. In individual cases, the spread of the short leg becomes negative (shrinkage). This was first detected by the author when rolling angle 90 x 56 x 6 mm.

B. P. Bakhtinov's formula can be used for accurately determining the lengths of the middle lines of the legs of the grooves.

The spread calculated by the proposed method yields results close to the actual. An analysis of the mutual position of the groove and the bloom being delivered into it showed that the angles do not coincide during delivery but are somewhat offset. Therefore, with large thicknesses, when a greater displacement of the apex angle occurs, the angle is filled worse and becomes less acute.

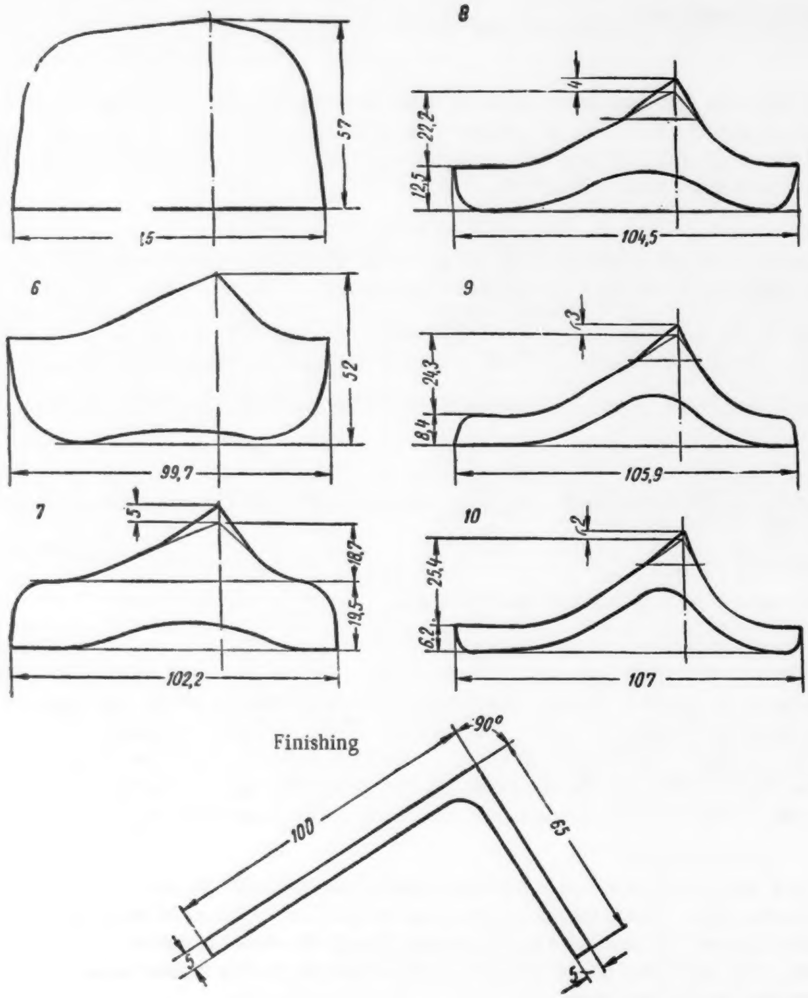


Fig. 1. Pass templet for rolling angle steel 80 x 50 x 6 mm: 5-10) grooves

The upper radius of the contour of the short leg and the height of the planishing groove can be selected so that the projection of the short leg, especially in the last passes in the rolling sequence, is 3-8 mm larger than the coordinate of the radius. In this case, rolling occurs more smoothly and fluctuations in the magnitude of the spread do not occur.

As is apparent from Fig. 1, a certain amount of metal is added to the apexes of the angles of the grooves. Such a groove design is found when sizing small angles and, unfortunately, is not used when rolling average and large angles,although it has substantial advantages. In the finishing groove, cases where the apex angle is not filled do not occur due to local deformation. It appears possible to regulate the width of the legs without the danger that the angles will not be filled; this is of considerable importance when adjusting. Breakage and second grades are sharply reduced and the output of the mill increased. The change in the design of the grooves in the conversion to rolling according to All-Union State Standard 8510-57 led to a 10-15% increase in the productivity, although the weight of one running meter of the shape was reduced by 3-4%.

The finishing groove permits rolling of L-shaped angle steel of different thickness and is designed for a free spread, whereby the projections of both legs to the vertical axis are equal. With such a groove arrangement a change in the gap between the rolls causes an unequal change in the leg thickness, which is easily eliminated by the axial movement of the rolls. Therefore, a change in the thickness of the legs cannot be linked with the amount of angle steel of a certain thickness being rolled. However, this error is found in the literature.

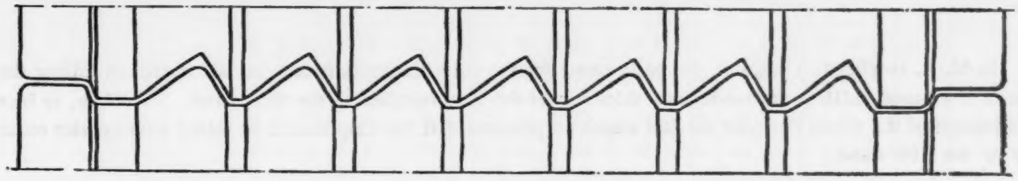


Fig. 2. The arrangement of the grooves on the finishing-mill rolls for rolling angle steel 80 x 50 mm and 90 x 56 mm.

In addition, in order to reduce the roll-changing time and to reduce the stock of rolls it is expedient to roll proximate angular shapes, especially in small batches in the same grooves which were designed for larger shapes. The negligible difference in the ratios of the length of the legs does not cause axial displacement of the rolls.

Figure 2 shows that arrangement of the grooves in the rolls of the finishing stand for rolling angle sheet 80 x 50 x 6 mm and 90 x 56 x 6-8 mm. When the set of rolls wears with respect to the diameter, the upper roll is reground to a lower roll for a new set, which reduces consumption of rolls by 35-40. Regrinding is done depending on the wear of each roll separately, and, therefore, by the end of the service life the ratio of the rolling diameters is slightly changed. In the finishing groove the horizontal projection of the short leg should be 2-3 mm greater than in the planishing groove. In a contrary case, at the instant the flat product is fed to the finishing groove, the end of the smaller leg can strike the roll shoulder, which will cause breakage in the shape.

It is not necessary to make passes in all shaping grooves, with the exception of the finishing groove. Here it suffices to install only guides,which assure a normal feed of the flat products. Passes are usually set up in the finishing groove which furthers a correct delivery of the flat products and permits regulation of the length of the legs.

While cooling off in the cooler, the shape is bent as a result of the uneven cooling of individual sections (a more massive section cools more slowly at the apex).

Since according to All-Union State Standard 8510-57 the allowable curvature has been considerably reduced (from 6 to 4 mm per running meter) and the over-all curvature stipulated, all angle steel (especially those that are long) must be straightened.

When rolling angle steel, the durability of the four-high set of rolls of the roughing stand is 20,000-25,000 t of rolled products and the decrease in the diameter for regrinding is 5-10 mm. In the finishing stand the set of rolls can roll up to 7,500 t.

ON THE SELECTION OF RATIONAL REGIMES FOR REDUCTIONS IN COLD-ROLLING TIN-PLATE

An article, "Two techniques for cold-rolling tin-plate in five-stand continuous mills," by M. A. Leichenko, was published in Metallurg (1960, No. 4). A comment on this article is printed below.

P. T. Kovtun

Lys'vensk Metallurgical Factory
Translated from Metallurg, No. 3,
pp. 27-29, March, 1961

In M. A. Leichenko's opinion, the basic cause for the strip tearing between the last strands in rolling tin-plate in five-stand mills is the inadequate thickness of the strip supplied to the fifth stand. Therefore, to increase the thickness of the metal between the last stands he proposes that the strip should be rolled with greater reductions in the fifth stand.

Observations made by us in 1957-1958 in rolling strips 0.25, 0.28, and 0.32 mm thick in a five-stand mill indicated that a large number of tears took place not only between the last, but also between the third and fourth stands, although the strip between them had thickness adequate to prevent increasing tension.

This was the basis for our considering that tears between the last stands cannot be explained only by inadequate strip thickness.

In our opinion, in determining the optimum schedules of reductions, in the first place it is necessary to consider the influence of the heat effect in the process of deformation on the strengthening of the metal and on the course of diffusion processes. Part of the energy absorbed by the deformation of the metal is transformed into heat energy and plastic deformation, as a result of which the plasticity is considerably lowered because of the strengthening and blocking of slip planes by finely dispersed particles which are precipitated in the temperature interval in which the formation of a dispersed phase is possible; or the plasticity is increased in the heat of deformation by the partial loss of strength and softening of the dispersed phases which are situated in the slip planes and had been precipitated during the reductions in the previous stands.

Consequently, cold-rolling should be carried out with such rates of roll revolution and such reductions that the increased heating of the metal should be ensured to be adequate to change dispersed phases from the brittle to the plastic condition and so that partial loss of strength should take place.

In rolling with large reductions in the first or in the first and second stands, the plastic properties of the metal are lowered mainly because of an increase in strength. In the following stands with a decrease in the reductions, the temperature generated may prove to be the most favorable for precipitation in the slip planes of finely dispersed particles which make further deformation difficult. As a result, the metals' plastic properties are almost entirely lost, and this leads to tearing of the strip during a sharp increase in tension.

To test this supposition, tensile tests were carried out on standard specimens cut from strips nominally 0.25, 0.28, and 0.32 mm thick, rolled at various times in the five-stand mill at Magnitogorsk Metallurgical Combine. The results of these tests (Table 1), although they do not correspond with the real conditions of deformation in the working rolls, nevertheless show clearly enough that the plastic properties of the metal after cold-rolling depend on the reduction schedules in the stands.

With large reductions in the first stand and small reductions in the last stand, the percentage elongation of standard specimens cut from strips after the fifth stand is very much less than with decreased reductions in the first and increased reductions in the last stand. After rolling with decreased reductions (20-25% in the first stand, increased and large reductions (38-43%) in the second, medium reductions (30-33%) in the third, large reductions (40-43%) in the fourth, and decreased reductions in the fifth, (25-28%), the metal has the same reserve of plasticity as after rolling with decreased reductions in the first stand and increased reductions in the last stand.

TABLE 1

Percentage Elongation of Specimens Cut from Strips after the Fifth Stand

Stand	Nominal strip thickness, mm											
	0,25				0,28				0,32			
	specimen number											
	1	2	3	4	1	2	3	4	1	2	3	4
	Reduction, relative / total, %											
1	40,9 / 40,9	22 / 22	28 / 28	27,2 / 27,2	25 / 25	22 / 22	45,4 / 45,4	27,2 / 27,2	43 / 43	22.7 / 22,7	25 4 / 25,4	22,7 / 22,7
2	46,9 / 68,6	43,3 / 57,7	36 / 53,6	40,6 / 56,8	31,2 / 50	38,2 / 52.2	43,3 / 70	37,5 / 54,5	40 / 66	35,2 / 50	31,7 / 49	38,2 / 52,7
3	34,7 / 70,5	36,8 / 73,3	44 / 74	31 / 70	40 / 70	32,3 / 69,9	30.7 / 78,9	30 / 68	36 / 78	31,8 / 65,9	43,7 / 71	31,4 / 68
4	31 / 85,8	26,6 / 80	33,8 / 82,7	43,5 / 84	38,6 / 81,8	35,7 / 79,9	28,8 / 85,4	42,8 / 81,5	27 / 84	33,3 / 77,2	27 / 79,8	40 / 80
5	16 / 88,6	43 / 88,7	33,8 / 88,8	27,3 / 88,6	30 / 87,3	37,7 / 87,3	12,5 / 87,4	30 / 87,4	8 / 85,3	36 / 85,4	30 / 85,3	25,5 / 85,4
	Percentage elongation											
after fifth stand	1,8	4 2	3,6	4,1	.3,9	3,9	2,1	4,3	2,5	4,2	4,0	4,4

The use of large reductions in the last stand and an increased rolling speed ensures the localization of a considerable amount of heat in the slip plane, adequate for the development of diffusion processes and of partial loss of strength; because of this, the rolled strip has a guaranteed reserve of plasticity.

In the second case, increased reductions in the second and fourth stands oppose the metal's plasticity falling to the brittle condition.

After rolling with large reductions in the fourth stand (Table 2) the metal still has an adequate reserve of placticity, which, after rolling in the fifth stand with decreased reductions, is able to prevent tears during marked increase in back tension.

An increase in the strip's plasticity between the last stands, caused by the large reductions in the fourth stand, eliminates tears and makes the rolling process steadier without increasing the strip thickness because an adequate reserve of plasticity is retained.

In this way, a reserve of plasticity appears to be positively retained in the technique proposed by M. A. Leichenko (small reductions in the first and large reductions in the last stand) and in the technique with alterations of decreased and increased reductions. However, rolling with alterations of increased and decreased reductions has an advantage; namely it is possible to roll strip with comparatively little transverse difference in thickness, because a decreased reduction is used in the last stand and the strip between the last stands has a large reserve of plasticity.

The use of large reductions in the last stand lowers the accuracy of rolling, because elastic deformations arise in parts of the stand, which are caused by the high pressure of the metal on the rolls.

The increased variation is strip thickness leads to nonuniform reduction during temper-rolling; as a result of this, plasticity of the more reduced parts of the sheet is considerably lowered. This is one of the basic

TABLE 2

Percentage Elongation of Specimens Cut from Strips after Rolling in the Fourth Stand

Stand	Strip thickness after leaving the fourth stand, mm					
	0,35	0,37	0,40	0,44	0,44	0,50
Reduction, relative / total, %						
1	27,2 / 27,2	43 / 43	25 / 25	22 / 22	22,7 / 22,7	22,7 / 22,7
1	40,6 / 56,8	40 / 66	31,2 / 50	42,3 / 57,7	38,2 / 52,7	35,2 / 50
3	31 / 70	36 / 78	40 / 70	36,8 / 73,3	31,4 / 68	31,8 / 65,9
4	43,5 / 84	27 / 84	38,6 / 81,8	26,6 / 80	40 / 80	33,3 / 77,2
Percentage elongation						
after fourth stand	5,4	3,9	5,5	3,8	5,3	3,7

causes why tin-plate, rolled with large transverse differences in strip thickness, gives low figures in the Erichsen test.

We have established that, in the case of strip with increased differences in thickness, it is possible to obtain tin-plate of quite satisfactory plasticity if a recrystallization anneal is carried out until metal with isotropic properties or insignificant anisotropy is obtained, since well-annealed cold-rolled metal is less liable to exhibit an increase in strength, and because of this a small fall in plasticity takes place.

However, to obtain metal with the specified properties it is necessary to anneal it with a prolonged holding (not less than 12 hr) at a temperature not below 660° C. Therefore, the use of large reductions in the last stand clearly requires a raised annealing regime or a final stand of increased rigidity.

To obtain a uniform metal thickness after leaving the first stand, and to prevent overloading of the roll flanks, M. A. Leichenko proposes imparting to the metal a biconcave form by the method of rolling in upper and lower rolls with convex flanks. This will make it easier to eliminate longitudinal inequalities in the thickness of hot-rolled strips and will create better rolling conditions in the following stands.

It should be noted that it is possible to obtain strip of such a form in cross section, having a uniform thickness along the coil, after reductions in the first stand up to 23%: with a rectangular form, the reduction may be up to 28%.

M. A. Benyakovskii and V. P. Volegov* consider that imparting a biconcave form to the strip in the first stand will inevitably provoke the formation of waves in the middle part of the strip, because of the large elongation of the metal, and will also make the setting-up of the mill and keeping the strip in the rolling axis difficult. In fact, with a reduction of 11% and a roll convexity of 0.04 mm, the middle part of the strip will be elongated 5% more than the edges: this will not exceed elastic deformations of the metal and will, consequently, not provoke waviness. Moreover, the formation of waves will also be prevented by the increased plastic rigidity of the metal, which, as is well known, is larger the thicker the sheet.

To keep the strip on the rolling axis and to facilitate setting up in the case of using upper and lower rolls with convex flanks, it is necessary, in the first place, to roughen the roll flanks in the first and second stands by the method of shot blasting and, in the second place, in machining the flank on all the rolls, it is necessary to adopt one of the ends as a regulating base and to place rolls in the stand so that these ends will face to a particular side: toward the driving frame or work floor.

It should also be noticed that to increase the rolling speed in the last stand, rolls with roughened surfaces should be used. This is to improve the gripping conditions since with an increase in the speed of rotation of the rolls these conditions are makedly impaired.

However, the introduction of measures carried out by the Urals Institute of Ferrous Metals to reduce tears and waviness in rolling thin strip, did not entirely eliminate these defects and did not make it possible to increase rolling speed above 12 m/sec. (The practical rolling speed was 8-10 m/sec.) Therefore, it is impossible to consider this work as completely conclusive and it needs to be continued.

It should also be noticed that the variation in the amount of carbon in the steel exerts an influence on the steadiness of the rolling process. Our observations have indicated that with a large variation in the carbon content

*Metallurg, No. 10, 1960

in soft steel (0,06-0.011% carbon in ladle sample or 0.03-0.08% carbon in the strip) the rolling becomes unstable because of the strip tearing with a carbon content at the lower limit.

Rolling goes on more successfully when the carbon content in the ladle sample is 0.08-0.11%.

HIGH-SPEED ROLL CHANGING OF THE STANDS OF THE CONTINUOUS MERCHANT MILL

Ya. E. Asser and M. M. Shapiro

Krivoi Rog Metallurgical Plant
Translated from Metallurg, No. 3,
pp. 30-32, March, 1961

The 250-1 continuous merchant mill at our plant (Fig. 1) is composed of 23 working stands, each with an individual drive. The stands are arranged in series in three groups: one roughing group (seven working stands) and two finishing groups (eight stands in each group). The finishing groups consist alternately of four vertical and four horizontal stands. The beds of the stands are of the open type. The distance between the rolls is regulated manually by a hand wheel for the upper roll and by a hand lever with a stop catch for the lower. A mechanism for axial regulation assures superposition of the grooves on the upper and lower rolls. Rolling in the roughing group is carried out in two passes and in the finishing groups in one pass. Rolling speed in the last stand of the finishing groups is up to 14 m/sec.

The mill rolls: rounds with a diameter of 10-20 mm, 10-20 mm fittings, 35 x 35 and 40 x 40 mm angles with a leg thickness of 4-5 mm, 16 mm squares. The starting blooms are 60 and 80 mm squares 12 m long. The rolls of the mill stands are changed in sets: the rolls of the horizontal stands are changed stand by stand and those of the vertical stands by adapters with vertical rolls set in them.

The mill is laid out as three sections of platforms for preparing the stands for roll changing: for assembling the stands of the roughening group, assembly of the horizontal stands of the finishing groups, and assembly of the vertical stand adapters. All operations necessary to prepare for roll changing and the adjustment of the rolls are done on the platform. In addition, inlet and outlet fittings are installed on the horizontal stands. The fittings of the vertical stands are installed directly on the mill. A roll-changing brigade headed by a brigadeer under the supervision of the senior foreman prepares the stands on the platforms.

Changing the roll of one horizontal stand consists of the following operations (Fig. 2):

1) Disconnecting the water, lubrication, and lead-in of the stand from engagement with the pinion stand;
2) removing the stand by a crane from the slabs and setting it on the platform;
3) removing the new stand from the platform and setting it on the slab;
4) engaging the new stand with the pinion stand, connecting the water, lubrication, and arranging the stand with respect to the axis of the rolling.

A special mechanism for moving the working stand with the electric drive serves to engage and disengage the horizontal stands with the pinion stand.

The adapters with the vertical rolls are moved by an electric carriage which moves along special guides. The adapters inside the frame of the stand are moved by machinery.

Changing the rolls of the vertical stand includes the following operations (Fig. 3):

1) Removal of the inlet and outlet fittings, disconnecting the lubrication;
2) disengaging the adapters from the pinion stand and setting it on the carriage;
3) rolling the carriage out from the frame of the stand;

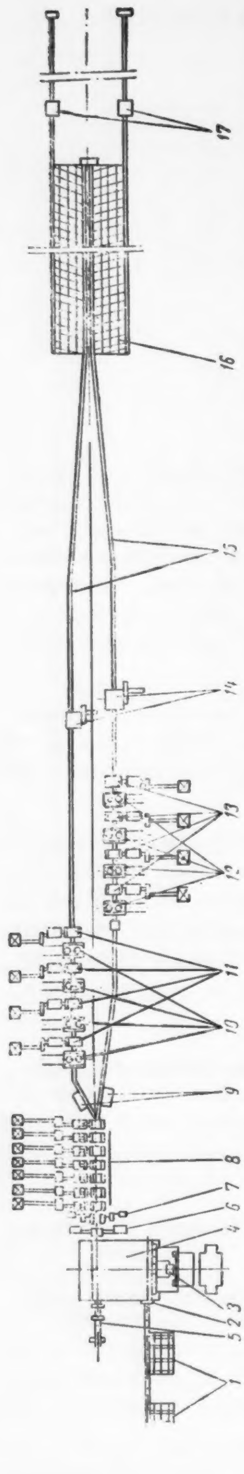


Fig. 1. Diagram of the 250-1 merchant mill: 1) Loading gate ; 2) pull-in device ; 3) bloom pusher ; 4) continuous heating furnace ; 5) distributing device ; 6) pull-out device ; 7) dividing shears ; 8) horizontal roughing stands ; 9) emergency shears ; 10) vertical stands of the left finishing group ; 11) horizontal stands of the left finishing group ; 12) vertical stands of the right finishing group ; 13) horizontal stands of the right finishing group ; 14) single-drum shears ; 15) roll table ; 16) coolers ; 17) cold-cutting shears of 600 t capacity.

4) removal of the adapter from the carriage ;
5) setting a new adapter on the carriage ;
6) rolling the carriage with the new adapter into the frame of the stand ;
7) engaging the new adapter with the pinion stand and adjusting it with respect to the axis of rolling ;
8) installing the inlet and outlet fittings, connecting the lubrication.

Until the introduction of schedules, the rolls of all mill stands, or only several, were changed differently during each change. As a consequence of this, the work of the crane was organized inefficiently, which caused losses in time and, consequently, increased the over-all time of roll changing. The schedules for high-speed roll changing of the stands stipulates that the workers be posted during the process so that there is a minimum number of time breaks in the operation of the cranes. For all practical purposes it is impossible to completely eliminate the breaks at the existing speeds of moving the adapter and the carriage.

The organization of high-speed roll changing on all stands when converting from rolling rounds with a diameter of 10 mm to a diameter of 14-16 mm is carried out in the following manner. A total of eighteen men participate in changing the rolls, of which nine are roll operators and plumbers, five are operators of the control posts, and three are workers who remove the hot metal. Numbers in series are given to the participants for the best organization of the work. All the workers are arranged in three brigades. The first brigade of eight men (from No.1 to No. eight, inclusively) is occupied with changing the rolls of the right group, the second brigade, also of eight men (from No. 9 to No. 16) is occupied with changing the rolls of the finishing group, and the third brigade of 2 men represent the roughing group for roll changing. Later two more men are transferred from the finishing groups to work the roughing group. Two men change the roll on each stand.

The foreman at a shift-change meeting defined more precisely the responsibilities of each participant in roll changing.

The assembled adapters are delivered to the stand before changing the rolls and set at the stands whose rolls are to be changed, and the horizontal stands are left on the platform.

The fittings of the vertical stands are prepared in the wiring workshop, then the foreman of the stand checks them and an hour before changing the rolls, thay are taken and placed at the appropriate stand.

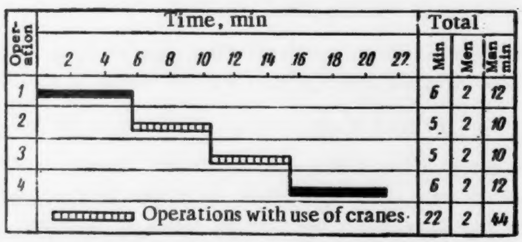


Fig. 2. Schedule for changing rolls of the horizontal stand.

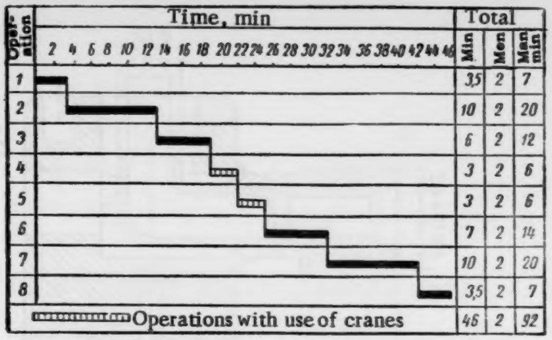


Fig. 3. Schedule for changing the rolls of the vertical stand.

The rolls are changed by two cranes with a lifting capacity of 20/5 tons. Two long, loud signals are given in order to shut down the stand for roll changing. On the first signal all workers must take their places, crane No. 1 approaches and stops over stand 23, crane No. 2 over 15. Roll changing commences with the second signal.

It takes two hours to change rolls; starting up, "firing," and adjusting the mill takes 30 minutes. Thus, the new shape of the mills starts to roll 2.5 hr after stopping for roll changing, while in 1958-59 this roll change took 4 hr.

The operational schedule of high-speed roll changing of the entire mill provides two breaks in the operation of the No. 1 crane with a total duration of 6 min, and on break in the operation of No. 2 crane with a total duration of 3.5 min.

After changing the rolls the groups are started up as they are ready and the rolls "fired" with the templets preheated in the furnace.

In conformity with the groove designing existing at the plant, seven schedules differing from each other in principle have been developed. But thay all provide for the most efficient arrangement of the workers, thus assuring continuous operation of the crane and the mechanism while changing the rolls.

RECONDITIONING THE CASES OF CUTTING TORCHES

L. N. Gorodetskii

Rail and Structural Shop of the Petrovskii Plant
Translated from Metallurg, No. 3
p. 32, March, 1961

Cutting torches, cases for which are made of rolled brass, are widely used in rolling shops for flame-scarfing metal.

When the normal burning conditions of the flame are disrupted, the seat of the oxygen valve in the case usually burns out, after which the case is put out of service.

A comparatively simple method of repairing the case was introduced at the rail-and-structural shop of the Petrovskii Plant.

First the case is bored out on a lathe (Fig. 1). Then the unique brass nipple is made separately and placed in the bored-out opening and welded to the case (Fig. 2). Such a connection guarantees the required seal and separation of the coke-oven gas and oxygen, the cross section of the channel for the passage of oxygen is increased.

The method proposed permits repeated reconditioning of the case, and with each repair 0.5 kg of brass is saved from which one new case can be made.

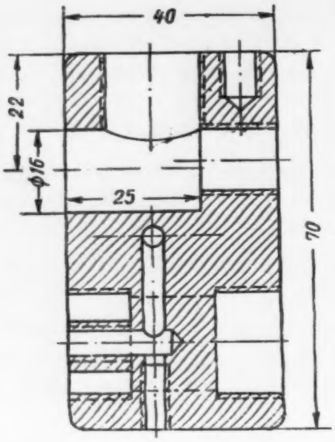


Fig. 1. Bored-out case of cutting torch.

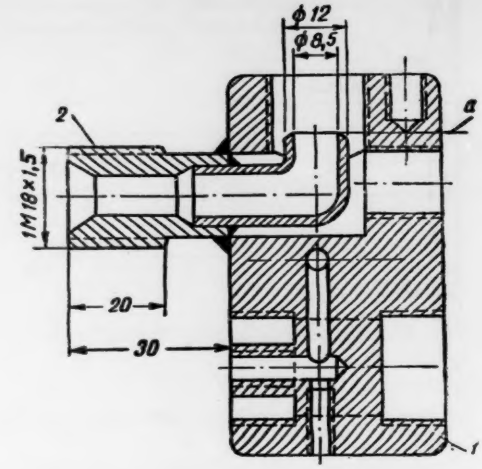


Fig. 2. Case of cutter with welded nipple: 1) case; 2) nipple; 3) level of seat of oxygen valve.

THE USE OF POWDERED-METAL HARD ALLOYS FOR HEADING OF FASTENERS

L. S. Feygin and E. A. Limina

Scientific Research Institute of Small-Component Production

Translated from Metallurg, No. 3, pp. 33-35, March, 1961

At the present time, cold heading firmly occupies a leading position in the manufacture of fasteners and other mass-produced parts which are used in all branches of machine, tool,and instrument building.

One of the most efficient methods to increase the profitableness of the cold-heading process is to increase the durability of the tool. This reduces its unit cost, lowers the amount of waste and breakage during adjustment, and increases the utilization factor of the equipment. In addition, the stability of the dimensions of an article obtainable owing to the increase in the durability of the tool also reduces waste in subsequent operations.

TABLE 1

Average Tool Durability for Cold Heading of Fasteners

Tool	Article	Article dimensions, mm	Hard alloy	Average durability of tool, thousands of units: with hard-alloy inserts	from carbon steel***
Upset die*	Bolt	6×25	VK15	900	50.0
		8×35	VK15	460	40.0
		12×55	VK15	100	30.0
		12×55	VK20	270	30.0
		12×55	VK25	400	30,0
		12×55	VK30	300	30,0
Preliminary punch*	Bolt	6×25	VK15	1200	70,0
		8×35	VK15	800	60,0
		10×45	VK15	600	50,0
		12×55	VK12	296	40.0
		12×55	VK15	324	40,0
		12×55	VK20	520	40,0
		12×55	VK25	365	40,0
Die of the IV operation**	Nut	6	VK15	900	100
		8	VK15	600	80
		12	VK12	74	50
		12	VK15	114	50
		12	VK15	405	50
		12	VK20	70	50

At the present time, a tool for cold heading of fasteners which are made mainly from high-carbon and high-chromium tool steel, is rapidly put out of service due to wear of the working surfaces and cracking, and does not provide long-time operation of the equipment.

Several years ago the "Krasnaya Etna" Plant in Gor'kii, the Likhachev and "Proletarskii Trud" Plants in Moscow, the Small-Components Metallurgical and Sizing Plants in Magnitogorsk at about the same time started usind dies with inserts of types VK8, VK10, and VK15 powdered-metal hard alloys.

The durability of a tool with hard-alloy inserts is considerably higher in comparison with carbon-steel tools (Table 1) and permits a sharp improvement in all indexes of cold heading.

The use of these alloys for heading large articles as well as the expansion of the assortment of tools with hard-alloy inserts proved to be impossible due to the high loss of the tool from cracking of the inserts.

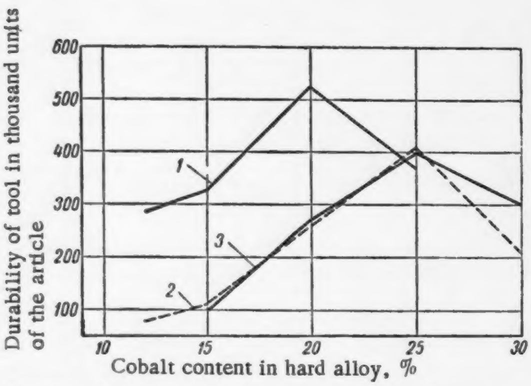
The Scientific-Research Institute of the Small-Components Industry and the All-Union Scientific-Research Institute of Hard Alloys together with the Magnitogorsk Sizing Plant and Small-Components Metallurgical Plant investigated the optimum types of powdered-metal hard alloys suitable for manufacture of large inserts and carried out studies for enlarging the nomenclature and tools with hard-alloy inserts for cold heading of fasteners.

Hard alloys are already being rather widely and successfully used in heading of fasteners with diameters up to 8mm ; therefore, the investigation was carried out for the manufacture of bolts and nuts with a diameter of 12 mm. The tools having the lowest durability were subjected to checking; upset dies and preliminary (first impact) punches for the manufacture of bolts and dies of the IV operation (forming hexagonal nuts) for heading nuts from rounds.

The inserts were made of VK20, VK25, and VK30 powdered-metal hard alloys. The durability of inserts made of VK12 and VK15 alloys were also checked for comparison.

The durability of the tool with hard-alloy inserts was tested on industrial equipment at the fastener shop in Magnitogorsk.

An increase in durability with an increase of the content in the alloy was common for tools of all types (see Fig.). However, maximum tool durability is attained by using different alloys for making the inserts. Thus, for inserts of the preliminary punches the maximum durability is obtained when they are made of VK20 hard alloy. All inserts of the punches worked until completely worn out. When using VK15 alloy for inserts, more than 50% of them crumbled and cracked. Inserts of VK25 hard alloy rapidly wore out.



Tool durability versus cobalt content in hard alloy: 1) Durability of preliminary punches when making M12 bolts; 2) durability of the dies of the IV operation when heading M12 hexagonal nuts from rounds; 3) durability of upset dies when making M12 bolts.

Inserts of VK25 alloy showed the greatest durability for the upset dies which operate under the heaviest conditions and which undergo large radial forces; all these inserts worked until completely worn without cracking. This is explained by the increased content of cobalt in this alloy.

Inserts of VK15 alloy showed a considerably smaller durability and all were put out of service due to cracking. Inserts of VK30 alloy also worked less satisfactorily than those of VK25 alloy and many of them cracked.

The dies of the IV operation with hard-alloy inserts for heading M12 nuts from rounds showed results in durability similar to those obtained when testing upset dies for bolts.

On the basis of these studies recommendations were made for the use of powdered-metal hard alloys for inserts of cold-heading tools (Table 2).

We must point out that other factors besides the type of steel also influence the obtainment of satisfactory results in the durability of cold-heading tools with hard-alloy inserts.

TABLE 2

Powdered-Metal Hard Alloys for Inserts of Cold-Heading Tools

Tool	Article	Article diameter, mm	Recommended hard alloy
Upset die	Bolts	6—8 10 12—16	VK15 VK20 VK25
Preliminary punch	Bolts	6—10 12—16	VK15 VK20
Dies for IV operation	Nuts	6—8 10 12—16	VK15 VK20 VK25

TABLE 3

Magnitude of Tightness for Press-Fitting Hard-Alloy Inserts into Casings

Tool	Diameter of article, mm	Recommended interference, mm
Upset dies, preliminary punches and dies:		
IV operation	6–10	0.1–0.14
Same	12	0.15–0.18
"	16	0.22–0.25

Powdered-metal hard alloys have a high wear resistance, small tensile strength, and cannot resist tension arising from the radial forces of the insert. Hard-alloy inserts therefore should be press-fitted with a definite interference into the steel casings (Table 3).

It is necessary to note that both extreme and insufficient interference lead to premature wearing out of the inserts due to cracking.

The material for the casings should have elastic properties and, simultaneously, a high viscosity in order to absorb the stresses from the heading forces. At the present time most plants widely use alloyed structural steel 30KhGSA for manufacture of the casings.

The construction of the tool, condition of the equipment, and technical maintenance have considerable effects on the durability of the instrument. The presence of play in the couplings of the moving parts, careless adjustment, and cases of press-fitting articles into the tool lead to impacts on the inserts and extreme overloads, which put the inserts out of service.

In order to accelerate the use of tools with hard-alloy inserts it is necessary to organize their centralized manufacture at specialized plants outfitted with the necessary equipment.

CREATIVE DARING

I. Shapoval

Translated from Metallurg, No. 3,
p. 35, March, 1961

If we were to open an album of distinguished people of the Petrovskii Plant we would find a photograph there of one of the oldest workers of the plant, chief of the roll-lathe shop, communist, P. G. Levin.

He arrived as a thirteen-year-old youth at the yard shop of the old Bryanka Plant (now the Petrovskii Plant). Here he came in contact with the well-known revolutionaries Petrovskii, Averin, Gopner, and others. This played a definite roll in his later life. In 1917-1918, P. G. Levin actively participated in fights with the white Guards. When the plant began to manufacture armored cars, he, along with other workers, built No. 3 armored train, "The Power of the Soviets," and in this armored train left for the front near Tsaritsyn.

The great October socialist revolution opened unlimited possibilities for the young worker. At first he was an apprentice roll-lathe operator, then a lather operator, a rate-setter, foreman, supervisor, and, finally, chief of the roll-lathe shop of the Petrovskii Metallurgical Plant, the oldest plant in the Ukraine — this is the path of labor followed by P. G. Levin. He has devoted almost a half century to his plant. During this time he created much that was new, needed, and interesting. He has helped many people with his valuable advice.

Comrades Alimov and Verner, roll operators at the plant, actively participated in perfecting the 550-mill. P. G. Levin did not lag by the wayside in this important matter. On his suggestion the operation of individual mechanisms of the mill were improved. As a result of such joint work the output of the rolling mill was tripled.

P. G. Levin and his apprentice roll-lathe operator, A. Ivanov, introduced another valuable suggestion. They called attention to the fact that near the rail-and-structural shop, worn-out rolls were heaped which are later sent on for resmelting. The innovators suggested that all the worn-out rolls be reground from a diameter of 800 mm to 500 mm and again put into operation. This saved the plant about 12,000 rubles.

On P. G. Levin's suggestion, efficient milling of the rolls for the blooming stand of the wire mill was used at the plant. This considerably facilitated the labor of the forge rolling-operators. In addition, the need for notchers of the rolls was completely eliminated. A simple milling machine has taken over their work.

While observing the operation of the blooming mill, P. G. Levin noted that roll ragging in bands does not produce a good bite on the bloom. The experienced skilled worker suggested replacing the existing ragging with transverse ragging. This improved the bite on the bloom, assured a smoother operation of the mill, and increased the quality of the rolled product. The plant is already using the more efficient transverse ragging.

But P. G. Levin is not only an experienced engineer and excellent producer, he is a remarkable teacher, enthusiastically passing on his rich experience to the factory youths. He has instructed many people in the operation of a roll-lathe. Among them are the foremost lathe-operators Comrades Kuz'kin, Zaikin, Rudenko, Sorokin, Ivanov, and others. He is well known at the Lutugin and Dnepropetrovsk Roll-Casting Plants.

The advice and critical comments of this experienced roll-lathe operator and rolling specialist have been invaluable to the founders, the creator of rolls.

EXPERIENCE OF OPERATING GAS-REGULATING POINTS

A. M. Fleyshmakher

Foreman of the Gas-Distribution Point of the Il'ich Plant

Translated from Metallurg, No. 3,
p. 36, March, 1961

On the gas-regulating points for natural gas at the Il'ich Plant we installed high-pressure VO (air opens) regulators with an air drive to the type 25s50nzh control regulator of 64 kg/cm^2; these high-pressure regulators reduce the gas pressure from 11 to 9 atm (gage) (gas-distribution point (GPR) No. 1 is the main one at the plant) and from 9 to 4 atm (gage) (the GRP of the blast-furnace shop supplies all blast furnaces).

The open-hearth shop has two shop distribution points (TsRP) for blocks No. 1 and 2, which reduce that gas pressure by 9 atm (gage) for all open-hearth furnaces.

The continuous and heat-treatment furnaces operate on natural gas at a pressure of 300-350 mm H_2O; and therefore, to reduce the gas from 9 atm (gage) to 300-350 mm H_2O we used pilot gas-pressure regulators of the RDS type (network) with a KN and KV (Kazantsev) control regulator in an assembly with a PK safety valve and gas filter. Such regulators were installed at the TsRP-1, TsRP-2, GRP of the heat and power station, etc.

Low-pressure gas is used in the open-hearth shop to dry the ladles, dryers, and chutes. Filters for removing mechanical admixtures from the gas were installed in front of the pressure regulator.

Presently eight GRP of varying capacity are operating at the plant. The pilot-pressure regulators of the RDS type with a KN and KV (Kazantsev) control regulator have certain shortcomings. For instance, the housing of the main RDS regulator and the gas filter installed in front of the pressure regulator should have been made of ST. 3 steel and the thickness of the walls of the flanges of the pressure regulator and the gas filter need to be increased.

The gas filters frequently crack under tensile testing at the time of assembly or repair. There were several cases of the housings of the gas-pressure regulators and filters fracturing at the Il'ich Plant and thus the cast-iron filters were replaced by steel ones.

The PK safety valves, designed to switch off the gas in front of the RDS regulator during an increase or decrease in the gas pressure within established limits, must be improved. The lever system and their dependence on the coupling of the lever with the hammer is unsteady: the hammer slips off from the slightest jar, the lever system starts operating, the valve closes, and the delivery of gas stops; this can entail an emergency or the need to blow down the entire gas line in order to remove air from it.

On the VO and VZ (air closes) high-pressure regulators with an air drive, two or even three working lines are usually designed from a single air regulator. Under such an operation the sensitivity of gas pressure regulation is lost. Independent working lines with a single air regulator should be designed for normal operation of the gas-pressure regulators.

There are no formulas for determining the capacity of the gas-pressure regulators in the presence of different pressure drops in the operating instructions for the regulating VZ and VO valves with an air drive to the control regulator of 64 kg/cm^2 of types 25s48 nzh and 25s50nzh made by the "Krasnyi Profintern" Fittings Plant of the Vladimirskii Council of National Economy.

CASTINGS OF STONE

B.Kh. Khan

Institute of Foundary Practice, Academy of Sciences, Ukr. SSR
Translated from Metallurg, No. 3
pp. 36-37, March, 1961

Rocks, these are excellent raw materials for the cast-stone industry. Lava that solidified many ages ago is, so to speak, brought back to life in the furnaces at a temperature of about 1500°; the fusion flows out in a gentle stream and is transformed into articles which can serve people for many years.

For what purpose are such articles needed ? In order to answer this question, let us turn to figures. From 1 million tons of steel we can manufacture 850,000 "Moskvich" automobiles or 10,000 locomotives; approximately 1 million tons of steel become unsuitable due to corrosion and wear per year. In the chemical, coke by-product, and other branches of the economy where acids, emulsions, and other corroding materials are used or produced, machines and apparatus made of metal are rapidly put out of service. In the mining, construction, and power industries, pneumatic and hydraulic transportation equipment are widely used. Pulp, carrying with it a mass of abrasive particles, flows through long pipelines; compressed air drives sand, ore, and coal along pipes, and the metal is abraded, the pipe walls become thin.

But people have found a method to combat this harm; in so-called aggressive media and under conditions of severe abrasion, stone castings have begun to be used in place of metal, and these can successfully replace ferrous and nonferrous metals in different branches of the national economy.

Pipes made of stone castings are used instead of metal for transporting coal, coke, ore, cement, ashes, slag, sand, and other materials; a cast-stone pipe with a diameter of 100 mm and a wall thickness of 15 mm can withstand a pressure of 20 atm. The durability of such pipes is several times greater than the ordinary metal ones. Water lines, sewer lines, and other pipes made of metal can be replaced by the more durable and hygienic basalt pipes.

The growth of the chemical industry, especially the development of synthetic-materials production, has prompted the need for an anticorrosion apparatus, the production of which presently lags behind the demands of the economy. Parts for such an apparatus can be made from stone castings.

A stone casting has excellent insulation properties, and highly resistant insulators can be made of it. In one construction business it can be used for laying floors, facing walls, sills, slabs, and finally for the manufacture of sculptured ornaments. Even for the sugar and wine-making industries it is a most valuable material in the manufacture of different vessels, hoppers, chutes, and scrubbers.

Stone castings can be widely used in agriculture. Cast stone feed troughs are recommended at animal husbandry farms; the casting is an excellent material for silos, pits, and trenches. Vertical chutes, vessels for collecting manure, pipe lines for delivering water, and other devices can be made from it.

Experience established that one ton of cast stone permits a savings of 5-10 tons of cast iron and 3-5 tons of cast steel.

The cast-stone industry in our country develops with each passing year. Presently operating are the Moscow and Stalino Cast-Steel Plants, the stone-casting shops of Krivoi Rog, Pervoural, Norilsk, the white stone-casting shops at Vodniki in the Moscow region and in other regions.

Basalt is the usual raw material for producing cast stone. But if there are no deposits of basalt nearby, local raw material whose chemical composition is close to basalt can be used. Such rocks can be diabase, amphibolite, hornblendite. If rocks cannot be used, a mixture of sedimentary rocks can be used: clayey shales, spondylous clays, sands, dolomite, and limestone. For example, the Moscow plant operates on a mixture of rocks and the Stalino plant on a mixture consisting of sedimentary rocks. The main constituent of the mixture at this plant is the burnt rock of the mine rock dumps.

It is not always easy to correctly select the mixture, the smelting technology, crystallization, cooling, or to obtain a good product and produce the needed casts for the economy.

And the need for such articles is enormous. For example, at the coal concentration factory the chute for transporting coal, made of sheetsteel 1 cm thick, is eroded by the flow of coal after eight to ten months, while this same chute faced with cast stone stands up for years.

The Yuzhnyi Ore-Concentration Combine at Krivoi Rog is stopped for repairs almost every month because the "tailings-line" is out of service (this is a long steel chute along which water flows bearing particles of the gangue removed from the ore). Now that a stone-casting shop has been created at the combine, the "stone" chutes serve considerably longer than the steel ones.

Recently the Stalino plant mastered the production of balls for milling units of coke by-product plants. Such balls are 2.5 times lighter than those of metal and last several times longer.

The production of cast stone is a complex and fine technological process which requires constant research. In 1959 at the Institute of Foundry Practice of the Academy of Sciences, Ukr. SSR a cast-stone department was organized which developed the technology of producing casts of amphibolite from the Cherkass region and from the basalts of Transcarpathia. In conjunction with other institutes and plants, studies are being carried out for the development of machines for centrifugal casting of pipes made of stone and double-layered tubes with an outside shell made of cast iron and inside shell of stone. Studies have started on the investigation of crystallization of casts under the effect of vibrations. This will partially eliminate hot working.

The richest reserves of raw material for the stone-casting industry are in the Ukraine. Basalts are in the Rovno, Stalino, and Transcarpathian regions; diabases in the Poltava region; rocks from mine dumps in the Donbas; this is an excellent base for developing the industry of the republic. An expansion of the existing and the construction of new enterprises is proposed in the Seven-Year Plan.

The mastering of new types of cast-stone articles and the replacement of metal parts by them will release hundreds of tons of ferrous and nonferrous metals for the needs of the national economy and save millions of rubles of state funds.

LARGE METALLURGICAL CENTER OF THE KOREAN PEOPLE'S DEMOCRATIC REPUBLIC

A. M. Shokin

Reviewer on affairs of the Korean People's Democratic Republic for the Department of International Book Exchange of the V. I. Lenin State Library.

Translated from Metallurg, No. 3,
p. 38, March, 1961

The Hwanhe Plant is the heart of ferrous metallurgy in the Korean People's Democratic Republic. It is located in the city of Kyomip'o, the center of socialist industry in the Republic. Rich deposits of iron ore are in Kyomip'o and in adjacent regions.

The Hwanhe Metallurgical Plant has more than 60 shops, including blast-furnace, steelmaking, rolling, wire-drawing, sheet-and plate-steel, coke, refractory, transport, machinery, etc.

The construction of the plant began in 1914. The Japanese imperialists, who at that time occupied Korea, sent a group of their specialists to Kyomip'o. The local inhabitants, the Koreans, were forced to work on the construction of the blast-furnace, which produced the first pig iron in 1919.

The Korean people were severly exploited. They worked 12-14 hours a day and earned so little that they didn't even have enough to feed themselves, let alone their families.

In 1945, the Japanese imperialists were driven from Korea by the Soviet Army, and only then did the Korean workers receive their right to live and work freely for the good of the country. According to the new 1946 law, the Hwanhe Metallurgical Plant was nationalized and became the property of the workers of the Korean People's Democratic Republic. Like the rest of the country, the working day was set at eight hours and a system of labor safety and social insurance introduced.

The Japanese, fleeing from justified punishment, destroyed and damaged the plant. Only thanks to the heroic efforts of the Korean workers and engineering and technical personnel was the plant restored in ten months. Already in the spring of 1950 the output of the Hwanhe Plant exceeded the highest level which had been attained under the Japanese. The plant achieved enormous successes in the technology of pig-iron production. Thus, the time between tappings was reduced from 8-9 hr to 6 hr, the volume utilization factor was reduced from 1.3 to 0.9. As a consequence of this, the pig iron output considerably increased during each cycle. The production of rails was set up at the plant.

On June 25, 1950, the peaceful labor of the Korean People's Democratic Republic was shattered by the armed attack of the American Imperialists and the cliques of Syngman Rhee. More than 18,000 various high-explosive and incendiary bombs were dropped on the territory of the Hwanhe Plant. Many shops of the plant were ruined. But no such evil deeds of the imperialists could frighten the people who rose up to struggle for the freedom and independence for their homeland. Three thousand workers of the Hwanhe Plant voluntarily went to the front. The workers remaining at the plant, in spite of the continuous bombardments, saved the equipment and machines by evacuating them to safe places. Whatever was difficult to transport was carefully camouflaged. The powerful and cumbersome fans, a large rolling mill, and large electric motors were left behind. When the enemy was driven

from Hwanhe province, the workers built and underground plant. Here electric motors, metal-cutting machines, and other equipment were installed. The inderground plant produced munitions.

A truce was concluded in 1953. Gaping shell holes were left from the enemy bombs at the site of the former Hwanhe Plant. A difficult task faced the workers: it was necessary not only to restore the plant but also to reconstruct it completely. The inhabitants of nearby regions and the soldiers of the People's army participated in the restoration. In ten months, on June 1, 1954, the Hwanhe Plant produced its first steel.

Since then, this industrial enterprise has attained remarkable achievements. Since March, 1959, the movement of Chenlim brigades, a new form of socialist emulation, has widely developed here. The workers of the plant submitted more than 600 suggestions for greater efficiency, most of which were introduced into production. As a result, the productivity of labor at the plant increased by 8.3% and the output of steel, pig iron, and rolled products was considerably increased. Automation at the plant is rapidly expanding.

The city of Kyomip'o grows along with the Hwanhe Plant. The larger part of its population are workers and office personnel of the metallurgical plant. Only one elimentary school was there before the country was freed. Now this city has the Communist University, a polytechnical institute, three technical schools, including a metallurgical school where workers of the Hwanhe plant study. The city has one high school and seven junior high schools as well as kindergartens, and day nurseries. The plant workers and members of their families are treated free in the polyclinic and nine dispensaries of the city. Beautiful, well-built four-and five-story houses stretch along the wide street, decorated by green squares and parks. All this was accomplished in the short postwar period on the site of rubble and smouldering ruins. The workers and administrative personnel of the plant vacation at rest homes and sanitoriums at the expense of the state.

It is possible to read about this plant in the brouchure, "The Hwanhe Metallurgical Plant," which was recently issued by the Foreign Language Literature Press of the Korean People's Democratic Republic. The brochure contains considerably factual material and interesting figures. It is richly illustrated with photographs depicting the work, study, and rest of the plant's collective of many thousands of workers.

Experimental and Model Metallurgical Plant

The Ukranian specialists have worked out a design for an over-all mechanization and automation of the Dzerzhinskii Plant.

In the blast-furnace shop the scale cars and railroad transportation for delivering raw materials to the furnace will be replaced by an automatized conveyor system and apparatuses operating according to a preassigned program.

Smelting will be controlled by computers and instruments which determine the optimum conditions for the melt, send comands to the slave mechanisms, and see to their fulfillment.

It is planned to finish the work by 1965. It is proposed that the labor productivity at the enterprise will be increased by this time by 110% and the output of metal by 32%.

Ultrasonic Waves Improve the Quality of Metal

Numerous experiments carried out by the Laboratory of Crystallization of the Scientific-Research Institute of Ferrous Metallurgy have shown that the best method for affecting the crystallization process is the use of ultrasonic waves. Ultrasonic vibrations disintegrate large crystalline grains in liquid metal and distribute them uniformly over the entire surface of the future ingot, the surface becomes fine-grained, without any flaws.

New Iron Ore Deposits in the Urals

New iron ore deposits have been found in the region of the Eastern Transurals. During a survey of the magnetic anomaly in the Kurgan region, a borehole reached strata of rich martite (oxidized) ores at 330 m. The well penetrated more than 50 m of the ore and still didn't pass through it. The new deposit is a continuation of the ore-bearing region where earlier the richest Sokolovsk-Sarbai (iron ore) and Gaisk (copper) deposits were discovered.

25-m Rails

The production of 25-m rails has been mastered at the Nizhne-Tagil Metallurgical Combine. Previously the combine manufactured rails 12.5 m long. By cutting down on butt bracings when laying the new rails, 3.5 t of metal will be saved for each kilometer of track. The cost will be less and it will be cheaper to operate such railways.

The Latest at "Amurstal'"

The open-hearth furnaces do not have front walls at the "Amurstal" Plant at Komsomol'sk-on-the-Amur. The advantage of furnaces of such construction is that the charge can be of larger sizes and it can be distributed uniformly throughout the entire bath of the furnace. In addition, the charging process is shortened and the furnace is easily inspected.

The Tagil Workers Confidently Approach the Projected Limit

During the two years of the Seven-Year Plan, the collective of the Nizhne-Tagil Metallurgical Combine has provided a considerably greater increase in the smelting of pig iron and steel and the output of rolled products than that called for in the plan. During this time the metallurgists of Tagil have sent to consumers more

than 200 heavy freight cars of products in excess of the plan. The Tagil workers resolved to achieve the level of rolled products, pig-iron and steelmaking marked for the end of the Seven-Year Plan in 1961-62.

A Daring Solution

The time for reconstructing the blast furnace arrived at the Voroshilov Alchevskii Metallurgical Plant. The new 65-m high furnace was built not far from the old one.

By means of special machinery the new furnace "crossed over" 20 m. The constructors set it on the foundation of the old furnace. Such a solution of a complicated problem permitted a savings of considerable state funds.

With the Speed of an Express Train

The Ural Machinery-Building Plant has begun the production of equipment for the country's largest furnace for cold running automobile body sheet steel that is being constructed at the Cherepovets Metallurgical Plant. Metal will be rolled on this equipment at an unprecedented rate, up to 25 m/sec. The flat products being rolled will pass through the working stand with the speed of an express train. Such assemblies have yet to be developed in a single country of the world.

Twelve Times Faster

A group of engineers and technical workers of the Izhevskii Metallurgical Plant have developed and introduced a new technology for drawing. According to the new technology the steel is heated in a fusion of salts at a certain temperature. Whereas the previous drawing speed was 40 m/min, it is now 500 m/min, i. e., 12 times faster.

The 4200-Plate Mill

The technological line of the 4200-plate rolling mill extends for hundreds of meters. The technological design of this grandiose assembly, destined for the Novolipetsk Metallurgical Plant was developed by the designers of the Novo-Kramatorsk Plant. Multi-ton blooms will be transformed into 4-m wide steel strip in the working stands of the mill. There are devices on the stand for removing the trimming of the rolled piece directly into the troughs of the charging machines that are installed on the railway platform.

"Steel-1" Has Undergone Testing

The controlling "Steel-1" computer, designed for continuous laying-out of metal strip on the second blooming mill, has been tested at the Magnitogorsk Metallurgical Combine.

The test, which lasted four days, showed satisfactory results. Now the machine has been given to the combine for experimental operation, which will be carried out by representatives of the plants that manufactured the machine and the workers of the organization that drew up the structural scheme.

M. S. KOVARSKII

Translated from Metallurg, No. 3, p. 40, March, 1961

The Presidium, Party Bureau, and local committee of the Trade Union of Workers in the Metallurgical Industry with deep sorrow report the death of former manager of the department of labor and wages, member of the Presidium of the Trade Union Central Committee, member of the Communist Party of the Soviet Union, Comrade Kovarskii, Mikhail Savel'evich, who passed away on February 3, 1961, at 55 years of age after a severe and prolonged illness.

Comrade M. S. Kovarskii worked for a long time in the metallurgical industry in the fields of labor and wages, occupying responsible positions at the Zaporozh's Coke By-Product Plant, the Il'ich and Kyibyshev Mariopol Plants, the Sinarskii Tube Plant, the K. Libknetkht Dnepropetrovsk Plant, and the Zakavkazskii Metallurgical Plant.

The collective of workers of the Trade Union Central Committee will long retain the bright memory of Comrade M. S. Kovarskii as a tactful and sympathetic comrade.

The Presidium and Collective of the Trade Union Central Committee of Workers in the Metallurgical Industry

THE I. P. BARDIN SCIENTIFIC RESEARCH INSTITUTE OF FERROUS METALLURGY ANNOUNCES A COMPETITION

Translated from Mettalurg, No. 3,
Inside Back Cover, March, 1961

The I. P. Bardin Central Scientific Research Institute of Ferrous Metallurgy Announces A Competition

for filling the staff (including those vacant) positions of chiefs of the laboratories and managers of groups-senior scientific co-workers of the following laboratories:

Automation and intensification of blast-furnace production; automation of steelmaking production; automation of rolling production; methods of automation; physical measurements; direct production of iron; steelmaking; vacuum metallurgy; converter steel; ferroalloys and special master alloys; the theory of metallurgical processes; heat engineering for new metallurgical processes; powder metallurgy; tin-plate.

The technology of continuous teeming of steel; machinery for the installations for the continuous teeming of steel; the development of continuous teeming of steel for large-scale metallurgy.

The technology of special steels; heat treatment; nickel economy.

The investigation of the economic efficiency of new technological processes; analysis of the operational indexes of ferrous-metallurgical enterprises; economic problems; standardization; production cost and profit.

Persons having a scientific degree of doctor or candidate of science, as well as engineers of the metallurgical enterprises with an industrial length of service in a specialty of not less than ten years are permitted to participate in the competition.

The period for presenting the material to the competition is until May 1, 1961. Applications are to be sent to the Director of the Institute at the address:

Moscow, B-5, 2nd Baumanskaya Street, house 9/23

It is necessary to append to the application a personal testimonial of transcript, autobiography, notarized copies of diploma of higher education and documents confirming scientific rank and degree, personal report from place of work, list of scientific works and reprints of major published reports.

Co-workers of out-of-town scientific research and educational institutions are not to participate in the competition.

Out-of-town persons accepted for the competition are provided with living space.

SIGNIFICANCE OF ABBREVIATIONS MOST FREQUENTLY ENCOUNTERED IN SOVIET PERIODICALS

FIAN	Phys. Inst. Acad. Sci. USSR.
GDI	Water Power Inst.
GITI	State Sci.-Tech. Press
GITTL	State Tech. and Theor. Lit. Press
GONTI	State United Sci.-Tech. Press
Gosenergoizdat	State Power Press
Goskhimizdat	State Chem. Press
GOST	All-Union State Standard
GTTI	State Tech. and Theor. Lit. Press
IL	Foreign Lit. Press
ISN (Izd. Sov. Nauk)	Soviet Science Press
Izd. AN SSSR	Acad. Sci. USSR Press
Izd. MGU	Moscow State Univ. Press
LEIIZhT	Leningrad Power Inst. of Railroad Engineering
LET	Leningrad Elec. Engr. School
LETI	Leningrad Electrotechnical Inst.
LETIIZhT	Leningrad Electrical Engineering Research Inst. of Railroad Engr.
Mashgiz	State Sci.-Tech. Press for Machine Construction Lit.
MEP	Ministry of Electrical Industry
MES	Ministry of Electrical Power Plants
MESEP	Ministry of Electrical Power Plants and the Electrical Industry
MGU	Moscow State Univ.
MKhTI	Moscow Inst. Chem. Tech.
MOPI	Moscow Regional Pedagogical Inst.
MSP	Ministry of Industrial Construction
NII ZVUKSZAPIOI	Scientific Research Inst. of Sound Recording
NIKFI	Sci. Inst. of Modern Motion Picture Photography
ONTI	United Sci.-Tech. Press
OTI	Division of Technical Information
OTN	Div. Tech. Sci.
Stroiizdat	Construction Press
TOE	Association of Power Engineers
TsKTI	Central Research Inst. for Boilers and Turbines
TsNIEL	Central Scientific Research Elec. Engr. Lab.
TsNIEL-MES	Central Scientific Research Elec. Engr. Lab.—Ministry of Electric Power Plants
TsVTI	Central Office of Economic Information
UF	Ural Branch
VIESKh	All-Union Inst. of Rural Elec. Power Stations
VNIIM	All-Union Scientific Research Inst. of Metrology
VNIIZhDT	All-Union Scientific Research Inst. of Railroad Engineering
VTI	All-Union Thermotech. Inst.
VZEI	All-Union Power Correspondence Inst.

Note: Abbreviations not on this list and not explained in the translation have been transliterated, no further information about their significance being available to us. — Publisher.

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Goskhimizdat	State Chem. Press
GOST	All-Union State Standard
GTTI	State Tech. and Theor. Lit. Press
IL	Foreign Lit. Press
ISN (Izd. Sov. Nauk)	Soviet Science Press
Izd. AN SSSR	Acad. Sci. USSR Press
Izd. MGU	Moscow State Univ. Press
LÉIIZhT	Leningrad Power Inst. of Railroad Engineering
LÉT	Leningrad Elec. Engr. School
LÉTI	Leningrad Electrotechnical Inst.
LÉTIIZhT	Leningrad Electrical Engineering Research Inst. of Railroad Engr.
Mashgiz	State Sci.-Tech. Press for Machine Construction Lit.
MÉP	Ministry of Electrotechnical Industry
MÉS	Ministry of Electrical Power Plants
MÉSÉP	Ministry of Electrical Power Plants and the Electrical Industry
MGU	Moscow State Univ.
MKhTi	Moscow Inst. Chem. Tech.
MOPI	Moscow Regional Pedagogical Inst.
MSP	Ministry of Industrial Construction
NII ZVUKSZAPIOI	Scientific Research Inst. of Sound Recording
NIKFI	Sci. Inst. of Modern Motion Picture Photography
ONTI	United Sci.-Tech. Press
OTI	Division of Technical Information
OTN	Div. Tech. Sci.
Stroiizdat	Construction Press
TOÉ	Association of Power Engineers
TsKTI	Central Research Inst. for Boilers and Turbines
TsNIÉL	Central Scientific Research Elec. Engr. Lab.
TsNIÉL-MÉS	Central Scientific Research Elec. Engr. Lab.-Ministry of Electric Power Plants
TsVTI	Central Office of Economic Information
UF	Ural Branch
VIÉSKh	All-Union Inst. of Rural Elec. Power Stations
VNIIM	All-Union Scientific Research Inst. of Meteorology
VNIIZhDT	All-Union Scientific Research Inst. of Railroad Engineering
VTI	All-Union Thermotech. Inst.
VZÉI	All-Union Power Correspondence Inst.

Note: Abbreviations not on this list and not explained in the translation have been transliterated, no further information about their significance being available to us – Publisher.